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LITERATURE

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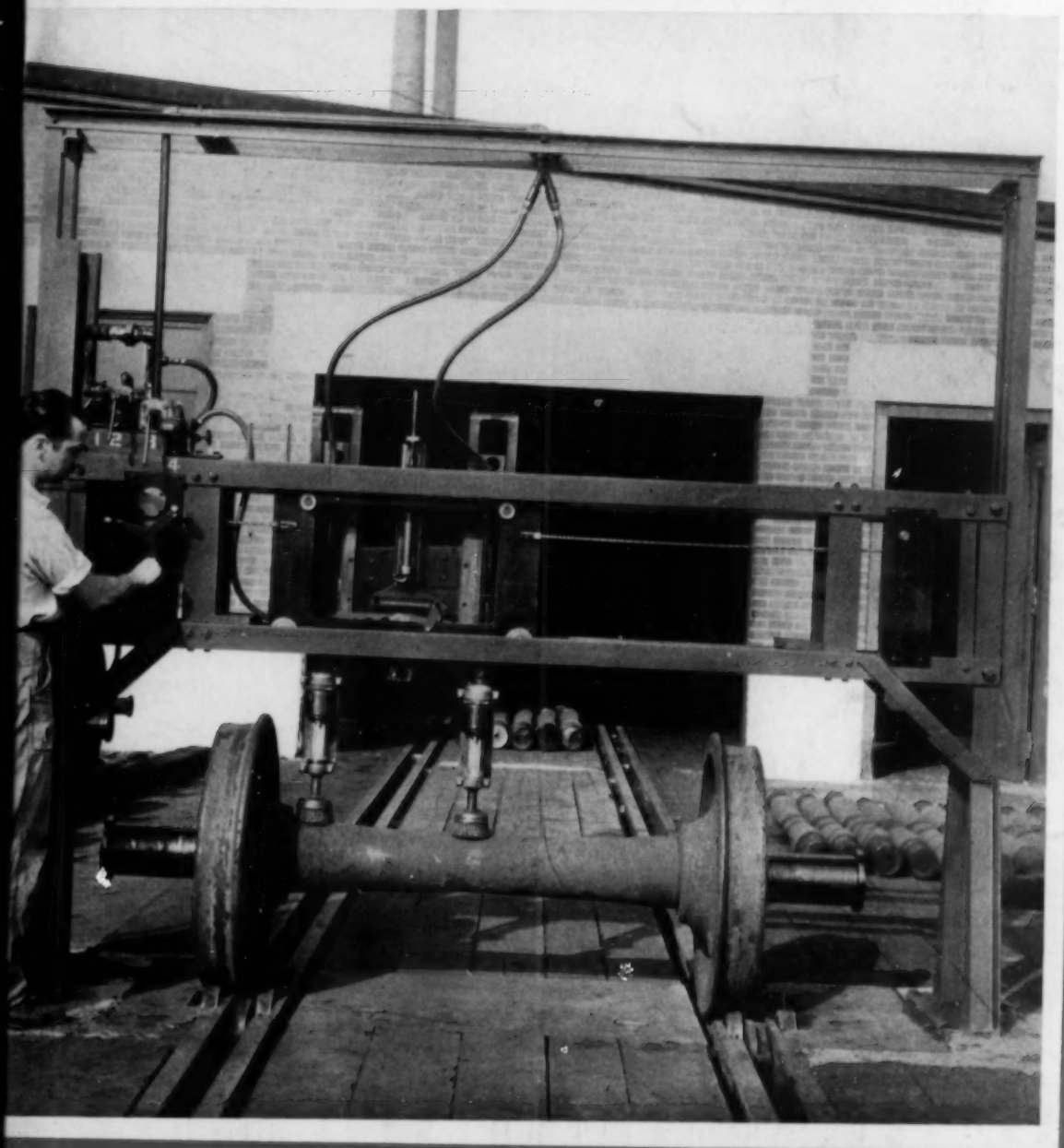
JULY - AUGUST - SEPTEMBER 1950



AIR-OPERATED
AXLE CLEANER

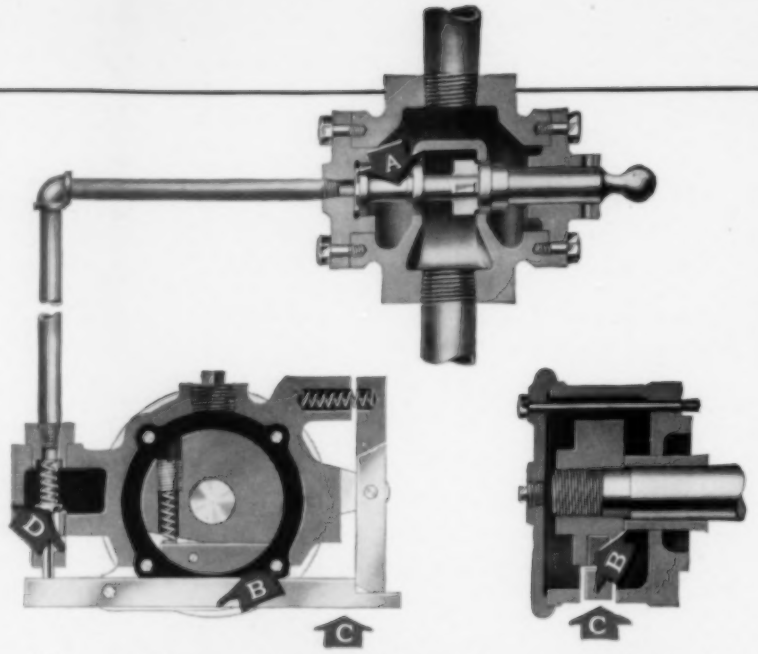
New York Central engineers design machine to expedite premagnafluxing treatment

(SEE INDEX PAGE AND PAGE 136)

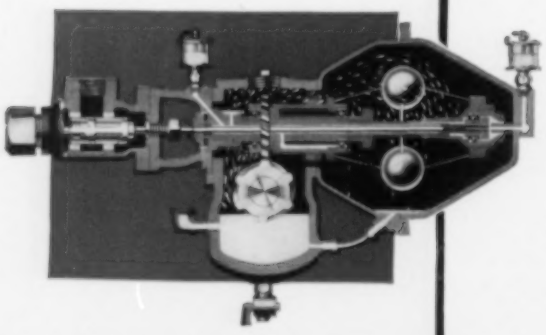
VOLUME 55 • NUMBER 7-8-9

NEW YORK • LONDON

Only Coppus Turbines offer you *a pilot operated* excess speed safety trip



The constant speed governor on Coppus Turbines, plus this Excess Speed Safety Trip, gives you extra protection for your turbine investments. Here's how it works. When steam is turned on, pressure opens valve A fully. When excess speed is reached, centrifugal force throws weight B against lever C lifting pilot valve D. This releases pressure in back of valve A, closing this valve instantaneously, to shut off the steam. Safety trip can be tested easily while turbine is running by manually tripping and resetting lever C.



Sectional view showing lubricating system of fully enclosed Coppus Constant Speed Governor. Governor head acts directly on stem of steam admission valve. No external levers required. Ball bearing construction eliminates end play and gives frictionless operation.

Coppus Turbines ranging from 150 hp down to fractional in 6 frame sizes

CUT YOUR COSTS PER HORSEPOWER

When you choose from the Coppus Steam Turbine line, you get the right size for your requirements . . . and make substantial savings on *any* size from the 150 hp turbine down to the smallest. Low in first cost, Coppus Turbines save you more money in the long run. Operating and maintenance costs are kept low by such other features as: large number of steam nozzles, controlled individually by manually operated valves; hard chromium plating on shaft at the stuffing box; replaceable cartridge type bearing housings; optional carbon ring packing assembly for back pressures up to 75 pounds.

WRITE FOR BULLETIN 135

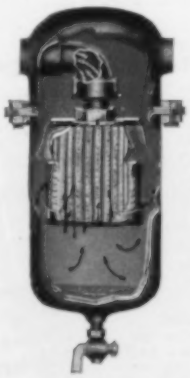
COPPUS ENGINEERING CORPORATION, 209 Park Ave., Worcester 2, Mass. Sales offices in THOMAS' REGISTER.

COPPUS "BLUE RIBBON" TURBINES

EXCLUSIVE *DOUBLE ACTION PRINCIPLE*
GUARANTEES BOTH CLEAN AND DRY AIR

1. MECHANICAL SEPARATION

Deflector cup directs flow of air or gas together with water, oil and dirt to the walls of the housing and thence downward at high velocity into the base where liquid and heavier dirt particles are deposited.



2. FILTRATION

Air or gas, having been mechanically cleaned, rises at low velocity through the Radial Fin Filtering element or insert which removes the lighter airborne material.

The popularity of Staynew Double Action Pipe Line Filters increases as manufacturing tolerances decrease—as vanes and pistons are closer fitted, orifices are made smaller, machines in general are built to more precise limits and processes are more scientifically controlled. Inexpensive, quickly installed and easily maintained, these filters provide highest filter efficiency with low overall maintenance.

IMPORTANT APPLICATIONS

Protection of Air-operated Tools ★ Paint Spray ★ Sand Blast ★ Air Displacement of Liquids ★ Air-operated Instrument Controls Liquid Agitation

COMPLETE DATA ON REQUEST

DOLLINGER CORPORATION

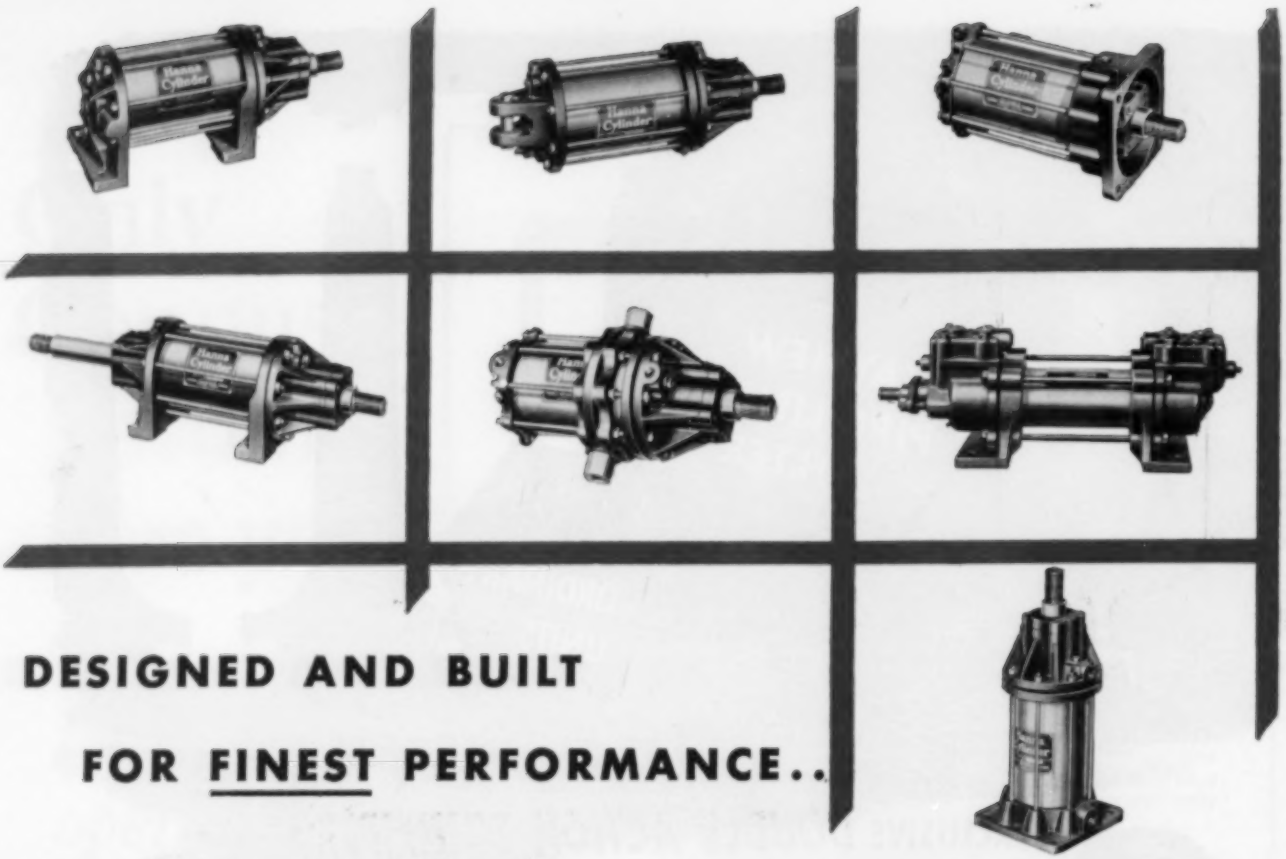
DOLLINGER REG. PROTECTOMOTOR U.S. PAT. OFF. STAYNEW FILTERS

7 CENTRE PARK ROCHESTER 3, N. Y.

IN CANADA: TORONTO, ONT. - McCarthy and Robinson
MONTREAL, QUE. - Engineering Equipment Co.

IN FRANCE: PARIS - Societe Tecalemit

MORE THAN 1,000,000 STAYNEW PIPE LINE FILTERS SOLD TO INDUSTRY



DESIGNED AND BUILT

FOR FINEST PERFORMANCE..

Hanna LOW PRESSURE Cylinders

... for 1001 applications

Trade-Mark of Quality

Look for the familiar Hanna Label on the finest cylinders. This name-plate is a symbol of fifty years of manufacturing top-quality pneumatic and hydraulic equipment.

Hanna Low Pressure Cylinders are used throughout industry to supply smooth, dependable, low-cost power for all types of machines and equipment. Hanna Cylinders are selected to provide the push, pull, lift, press, clamp or control that is needed. They get things done quickly, efficiently and economically.

Standard Model Low Pressure Cylinders are designed for operation up to 110 psi., but with minor modifications are suitable for higher pressures with air, oil or water as the operating medium. There is a Hanna Cylinder for nearly every power application . . . for nearly every mounting requirement . . . for many efficient uses in your machines or equipment.

SEND FOR ENGINEERING AIDS

Pneumatic Calculator... This handy "slide-rule" of pneumatic information shows at a glance the answers to many air power problems. It also helps in selecting air cylinders.

NEW CATALOG . . . Hanna Catalog No. 236 includes full information on the complete line of Hanna Low Pressure Cylinders.

Hanna Engineering Works

HYDRAULIC AND PNEUMATIC EQUIPMENT . . . CYLINDERS . . . VALVES . . . RIVETERS

1765 Elston Avenue, Chicago 22, Illinois

For Longest air hose Service at Lowest on-the-job Cost

check the Goodyear line

GOODYEAR INDUSTRIAL RUBBER PRODUCTS

G.T.M.-Specified TYPES OF AIR HOSE

EMERALD CORD—one-braid for small tools, two-braid for tough industrial jobs, three-braid for severest mine, quarry and construction use.

REDWING-H CORD—for rugged, direct-connection-to-compressor service.

WINGFOOT—for general industrial service, stationary compressor lines, light and medium pneumatic tool service.

STYLE MH AIR DRILL—mine, quarry and construction use needing large-size hose for direct-connection to compressors.

ORTAC—extremely lightweight, supple hose for air-cleaning and other general duty.

THERE's a Goodyear air hose for every application from small hand tools to heavy-duty quarry, mine and construction operations. Each is designed by the G.T.M. — Goodyear Technical Man—to give you the longest service at the lowest possible cost in the long run. All are available through your nearest Goodyear Distributor, so see him today.

FOR HOSE, FLAT BELTS, V-BELTS, MOLDED GOODS, PACKING, TANK LINING built to the world's highest standard of quality, phone your nearest Goodyear Industrial Rubber Products Distributor.

GOODYEAR

THE GREATEST NAME IN RUBBER

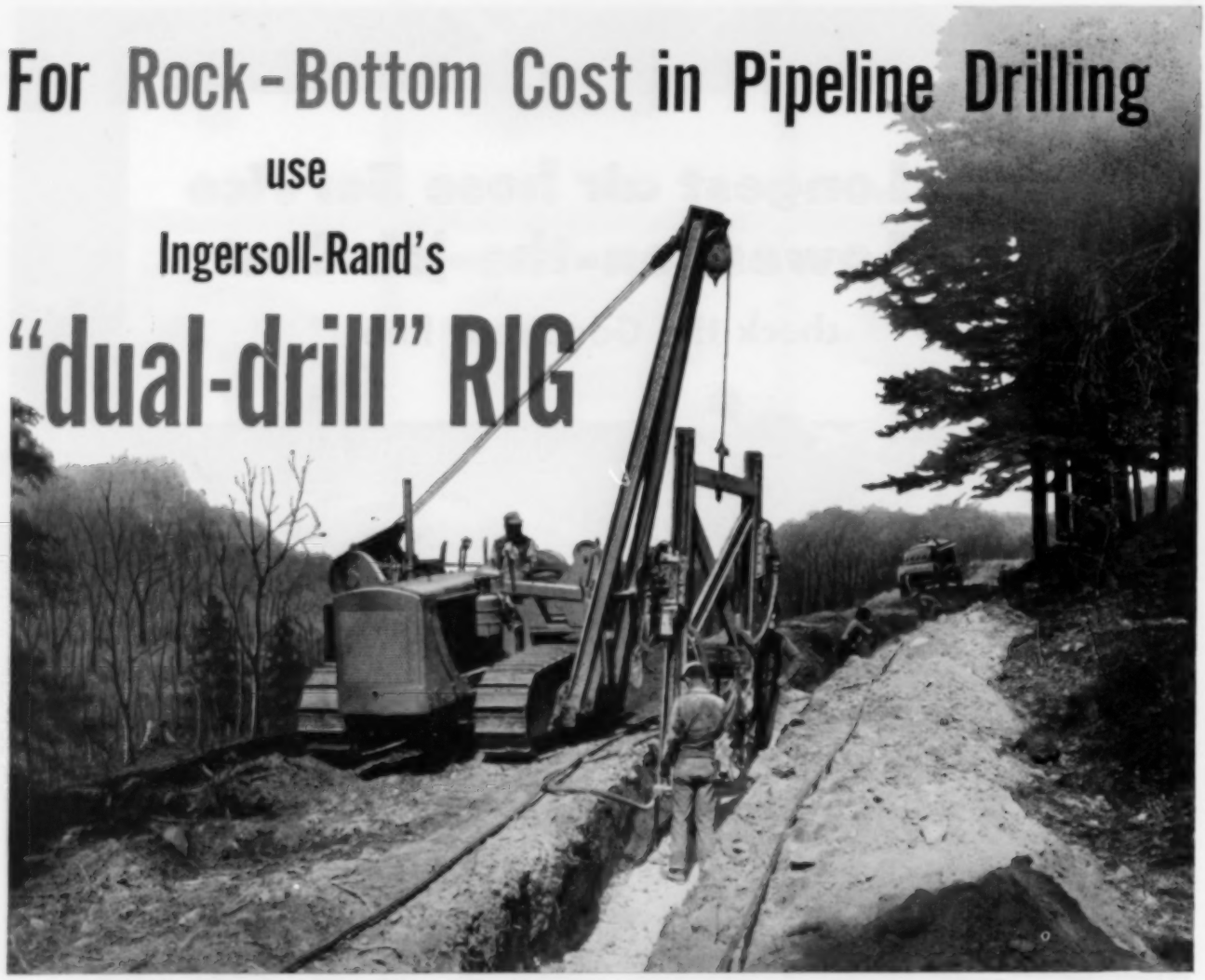
Emerald Cord, Redwing, Wingfoot, Ortac—
T.M.'s The Goodyear Tire & Rubber Company

For Rock-Bottom Cost in Pipeline Drilling

use

Ingersoll-Rand's

"dual-drill" RIG



For maximum all-around efficiency, you can't beat this complete I-R team:

- **I-R X71-WD "DUAL-DRILL" RIG**
- **I-R CARSET JACKBITS**
- **I-R MOBIL COMPRESSOR, IKA-500**

The Ingersoll-Rand "Dual-Drill" Rig is especially designed to permit faster, easier, and lower-cost pipeline drilling. With CARSET JACKBITS, operators drill two six-foot holes at a time, with no change of steel and practically no bit changes. Drilling time per hole is considerably reduced and the move to the next position is made in less than a minute.

The I-R "Dual-Drill" Rig utilizes the famous Ingersoll-Rand X71-WD Rock Drills proven for their excellent performance on wagon drills the world over. The Rig comes complete with controls, hose and lubricators on a rugged fabricated steel mounting. Control valves for drill feed, hammer action and hole blowing are at the operator's fingertips, conveniently located on the I-R air-feed motor. Simply hang the rig on your "boom cat", attach the air connections, and you're ready to go.

This "Dual-Drill" Rig, powered by an Ingersoll-Rand IKA-500 Mobil Compressor and equipped with faster-drilling, longer-lasting Carset Jackbits, gives you a fast-moving combination that pays off many times in reduced cost per foot of trench.

Your nearest I-R representative will be glad to give you the complete story.

Ingersoll-Rand

11 Broadway, New York 4, N. Y. 544-5

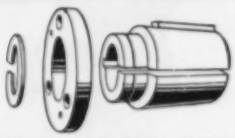
4 BIG ADVANTAGES!

ONE PIECE MOUNTING

Bushing and sheave go on together. One motion mounting. Alignment is easier. Sheave is on right first time.

POSITIVE DRIVE

Bushing is keyed to both shaft and sheave. No slipping. No sheared screws. No jammed bushings from bent screws.



FULL CIRCLE GRIP

Bushing split full length with separate collar. Grips shaft full length around full diameter. No forcing or distortion. Grip easily broken. No hammering.

WIDE SIZE RANGE

Magic Grip sheaves are available from 3" pitch diameter up. Style NC bushing for smaller sizes and Style C bushing for larger sizes.

MAGIC GRIP SHEAVE

YOU CAN MOUNT a *Magic Grip* sheave faster than any other sheave you can buy . . . and demount it just as fast. When you mount a *Magic Grip* sheave it runs true. It will not slip or jam. It always comes off easily.

Even if you don't change sheaves often, you should have *Magic Grip* sheaves on every drive to eliminate the possibility of shaft and bearing damage when ordinary sheaves are hammered or pried on or off.

WIDEST V-BELT LINE

Get everything you need for your V-belt drives from one reliable source. *Texrope* offers the broadest line of V-belts, standard and variable speed sheaves and speed changers in the industry. And you also get the extra engineering skill that comes from having more industrial V-belt installations than any other manufacturer.

Get your copy of the 144 page *Texrope* Pre-Engineered Drive Manual from your A-C Authorized Dealer or Sales Office or write for Bulletin 20B6956.

A-3022

ALLIS-CHALMERS, 1000A SO. 70 ST.
MILWAUKEE, WIS.

Sold . . .
Applied . . .
Serviced . . .

by Allis-Chalmers Authorized Dealers, Certified Service Shops and Sales Offices throughout the country.

MOTORS — ½ to 25,000 hp and up. All types.

CONTROL — Manual, magnetic and combination starters; push button stations and components for complete control systems.

PUMPS — Integral motor and coupled types from ¾ in. to 72 in. discharge and up.

Texrope and *Magic Grip* are Allis-Chalmers trademarks.

ALLIS-CHALMERS

What Every Operator Should Know .....About RING MATERIAL

HOW well a packing or piston ring performs depends to a large extent on the material of which the ring is made. For instance, a material which is especially well suited for a sour gas may give trouble in a compressor handling a sweet, clean gas or one handling a gas heavily laden with vapors and impurities.

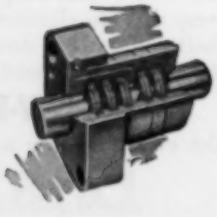
Because of the importance of matching the ring material to the specific gas and operating conditions, Cook has developed and maintains a complete range of ring materials for every service. These include many ferrous, non-ferrous and non-metallic substances, all thoroughly tested, all thoroughly proven.

Thus, you take no chances when you call in Cook engineers to make recommendations. Cook has only one interest in mind . . . to insure you of getting the very best in packing and piston ring service . . . and to provide the right material to do the job.

C. Lee Cook Mfg. Co., Incorporated, Louisville, Ky. Branch offices in Baltimore, Boston, Chicago, Cleveland, Houston, Los Angeles, Mobile, New Orleans, New York, San Francisco and Tulsa.

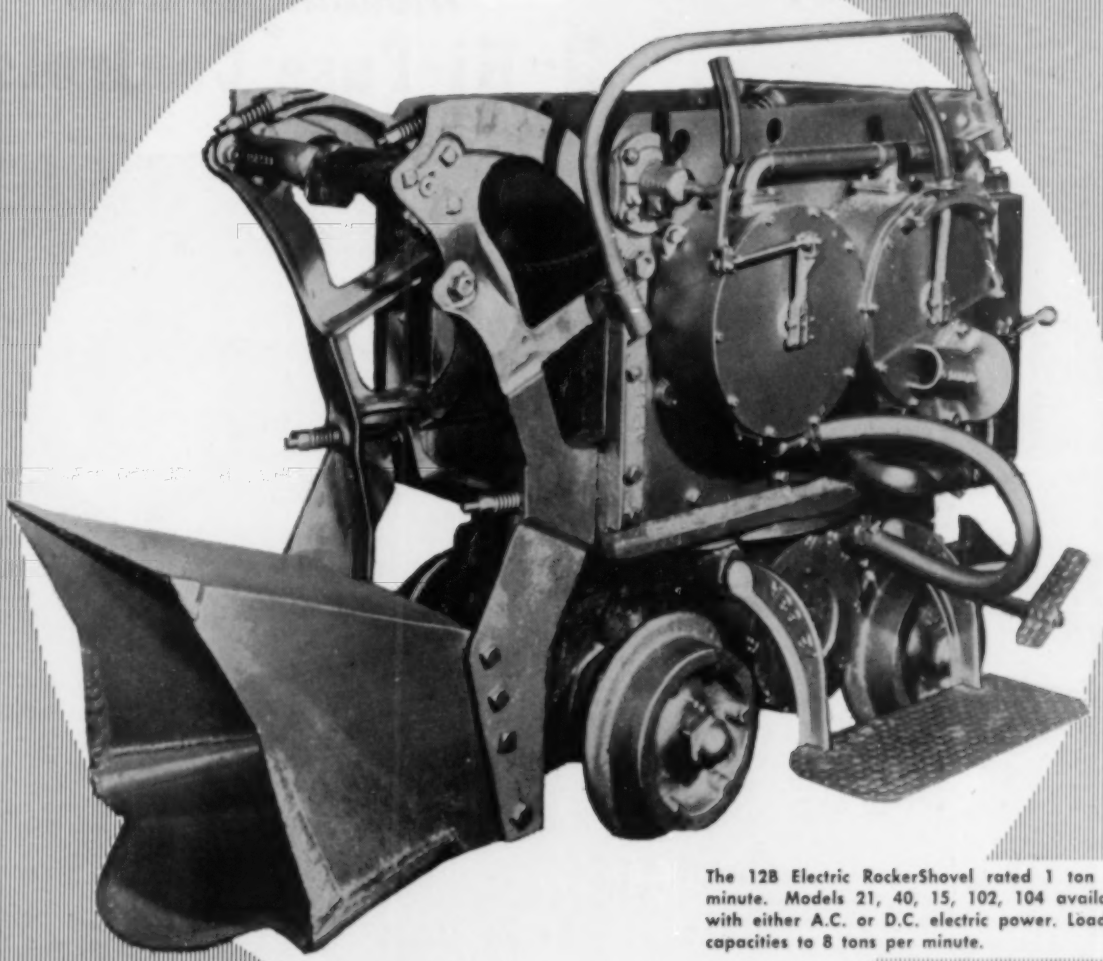
COOK

ROD PACKINGS



. . . SEALING PRESSURES SINCE 1888 . . .

EIMCO 12B Electric RockerShovel



The 12B Electric RockerShovel rated 1 ton per minute. Models 21, 40, 15, 102, 104 available with either A.C. or D.C. electric power. Loading capacities to 8 tons per minute.

Another first in the mechanical loading field is introduced by Eimco, the world's largest producer of underground rock loading machines.

The Eimco 12B machine is the smallest loading machine on the market with clean-up range, speed, power, stability and operating ease far superior to other machines in its class. The 12B Electric is the only small machine offered with electric power and duplicates its air powered relative in all the desirable characteristics of a loading machine.

The Electric 12B is available for A.C. power and with either permissible or non-permissible design. Overall caging dimensions are practically the same as the air driven machines: length (bucket up) 42", width (including controls) 37".

Write for more information giving complete power specifications.

EIMCO

A255

THE EIMCO CORPORATION

The World's Largest Manufactyrers of Underground Rock Loading Machines

EXECUTIVE OFFICES AND FACTORIES — SALT LAKE CITY 8, UTAH, U. S. A.

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AFFILIATED COMPANIES: SOCIETE EIMCO, PARIS, FRANCE
EIMCO (GREAT BRITAIN) LTD., LEEDS 12, ENGLAND

AGENTS IN ALL PRINCIPAL CITIES THROUGHOUT THE WORLD

Big Steel Fabricating Plant *Modernizes with* Hi-Fuse Controls

Men and Motors are protected by uniform, packaged units

E-M Hi-Fuse Controls replace live front controls in a Pennsylvania steel fabricating plant. Left to right are shown a full voltage Hi-Fuse Control for a 500 h.p. motor in the plant, reduced-voltage Hi-Fuse Control for 1100 h.p. motor, cubicle for reactor-starting of 1100 h.p. motor, and a blank cubicle for housing breaker on incoming line.

E-M Hi-Fuse controls are attractive, uniform units with deadfront panels for the safety of workers. They are designed to provide effective and economical protection for both synchronous and induction motors, and are available for use on systems which need interrupting capacities up to 150,000 kva at 2300 volts and 250,000 kva at 4160 volts.

Advantages of Hi-Fuse Control include:

1. Short-Circuit Protection
2. Motor Isolating Disconnects
3. Polarized Field-Frequency Starting
4. Complete Motor Protection
5. Safety for Operators
6. Adaptable to Group Line-up

Put these advantages to work in your own plant for more efficient motor operation and greater safety for employees. For more information, write for our publication 192.

ELECTRIC MACHINERY MFG. COMPANY
MINNEAPOLIS 13, MINNESOTA

3100-TPA-2079

KOPPERS K-SPUN POROUS CHROME* RINGS

boost pump service 2½ times!

Pasotex Pipeline Co., El Paso, Texas, pumps approximately 2000 barrels of crude oil per hour at 600 psi through this field installation of three Gaso Pump units. Pumps are equipped with moly iron liners and cast iron pistons with Koppers K-Spun Porous Chrome Piston Rings. Liners are interchangeable to permit varying capacities and working pressures of pumps.

GASO PUMP CO. *Cuts* cylinder wear—*Doubles* pump service—*Slashes* maintenance costs—with KOPPERS Piston Rings

Here's a job that's really hard on pumps—and piston rings! Thousands of barrels of pipeline crude oil go through these rugged Gaso Pumps . . . carrying with it abrasives and other impurities that constantly grind away at cylinder walls and piston rings. But amazing new Koppers K-Spun Porous Chrome Piston Rings take this rough, tough service right in their stride . . . *lasting more than twice as long as ordinary rings!* And that's not all . . . Koppers Rings *decrease cylinder wall wear up to 50%* in the bargain!

Here at last are the piston rings that cut "*down time*" and maintenance costs *in half* . . . lengthen the life span of expensive equipment . . . boost production and profits to a new high! Check into the operating costs of *your* equipment today . . . and next time you overhaul, specify Koppers Piston Rings . . . then watch costs go *down,* service go *up!*

Koppers complete engineering facilities are at your service. Whatever your piston ring problem may be, we're equipped to help you solve it quickly and economically. Write for information to: KOPPERS COMPANY INC., *Piston Ring Department,* 1597 Hamburg St., Baltimore 3, Maryland.

*Van der Horst process

WHAT IS KOPPERS K-SPUN?
Koppers K-Spun is an entirely new type of ring iron created by an exclusive centrifugal casting process, which forms graphite into large nodules instead of fine flakes. Large graphite nodules in K-Spun cast iron eliminate the many planes of weakness inherent in ordinary cast iron . . . impart to K-Spun *100% more strength, 50% more elasticity, four times more shock resistance!* K-Spun Rings are guaranteed not to break in installation or in service! Available up to 12½" diam.

WHAT IS KOPPERS POROUS CHROME?
Koppers Porous Chrome is a chrome-plated ring with a *porous surface* that holds and distributes oil during break-in, quickly wears down to perfectly seated *solid chrome* that prevents grit or other particles from imbedding themselves in the ring surface and scratching cylinder walls. Porous Chrome Rings last up to four times as long as ordinary rings, reduce cylinder wear 50% or more! Available in any size on specification in quantities of 100 or more.

KOPPERS

KOPPERS *American Hammered* PISTON RINGS

Put these cost cutting "teeth" in your drives—

40% more h. p. per belt
smaller pulleys
fewer belts
longer belt life

WITH DAYTON COG-BELTS*

The premium Dayton Cog-Belt gives you 40% more h.p. delivery from every V-Belt on a drive. You can use fewer belts and smaller pulleys, save on the over-all cost of belting, because 5 Dayton Cog-Belts do the work of 7 ordinary V-Belts!

Cog-Belts are "built to bend" (easily as your finger bends), ride around pulleys without compression strain and loss of power. Flexibility and strength are multiplied, belts run cooler, last longer.

To end V-Belt troubles—save on drive space, simplify maintenance, convert easily from flat to V-flat—get Dayton Cog-Belts. Ask your Dayton Distributor—(he also has the famous Dayton Thorobred V-Belts for the thousands of ordinary power transmission drives).

$2,100 is A Lot Of Bricks!

The brick machine flat-belt drive was slipping, slowing production. Several V-Belt engineers said conversion to a V-flat drive was impossible without a new motor and pulleys, costing over $2,400. The Dayton Distributor belted the drive with 20 DX-300 Dayton Cog-Belts, one new pulley. Saving: $2,100. Moral: Nothing grips like a Dayton Cog-Belt!

DAYTON RUBBER COMPANY, DAYTON 1, OHIO

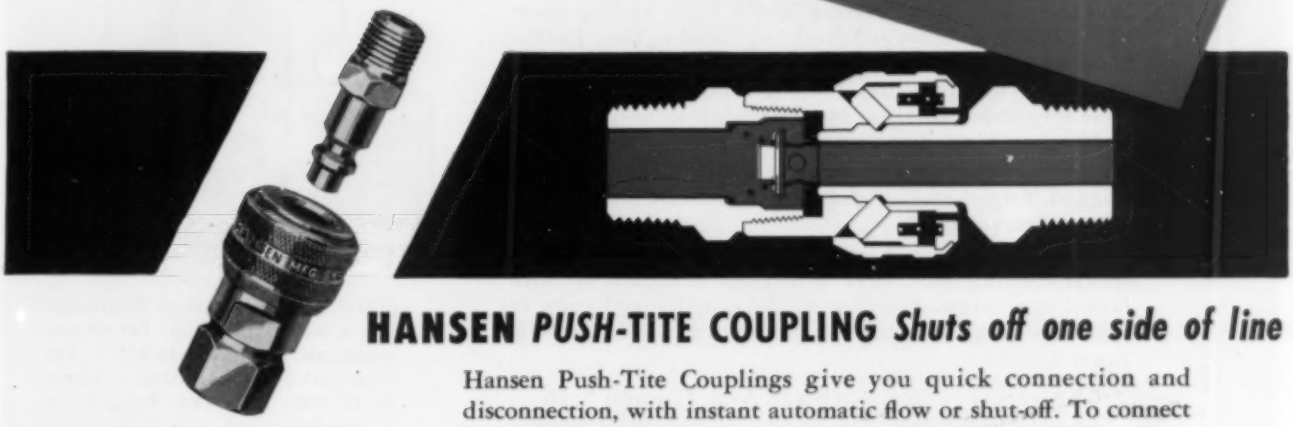
Dayton Rubber

WORLD'S LARGEST MANUFACTURER OF V-BELTS

HANSEN

QUICK CONNECTIVE SHUT-OFF COUPLINGS

HYDRAULIC • PNEUMATIC



HANSEN PUSH-TITE COUPLING
Cross-section at upper right shows flow through coupling when connected.

HANSEN *PUSH*-TITE COUPLING *Shuts off one side of line*

Hansen Push-Tite Couplings give you quick connection and disconnection, with instant automatic flow or shut-off. To connect coupling, and open line to flow of fluid, you merely push plug into socket. To disconnect, a slight pull on sleeve releases plug and shuts off supply end of line. Free swiveling plug prevents hose kinks.

HANSEN SERIES HP 8000
Shuts off both ends of line when disconnected.

HANSEN *HIGH-PRESSURE 2-WAY Shut-off* COUPLING

To connect, merely pull back sleeve and push plug into socket. Identical torpedo type valves permit free flow of gas or liquid through coupling. To disconnect, just pull back sleeve—coupling immediately disconnects, valves automatically and instantly seal both ends of line. Can be mounted to disconnect automatically where fluid lines may be subject to sudden, damaging strain.

REPRESENTATIVES

BALTIMORE
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Export Department: CLEVELAND

QUICK CONNECTIVE FLUID LINE COUPLINGS

AIR • OIL • GREASE • HYDRAULIC FLUIDS • REFRIGERANTS
STEAM • OXYGEN • ACETYLENE • GASOLINE
COOLANTS • WATER

HOSE CLAMPS • HOSE CLAMP PLUGS
HOSE CLAMP SOCKETS • HOSE CLAMP COUPLINGS

Write for Catalog giving descriptions and sizes of complete Hansen line of straight through and shut-off couplings for hydraulic and pneumatic connections.

THE HANSEN MANUFACTURING COMPANY

4031 WEST 150th STREET • CLEVELAND 11, OHIO

Profitable way to purchase piping ... Get everything from CRANE

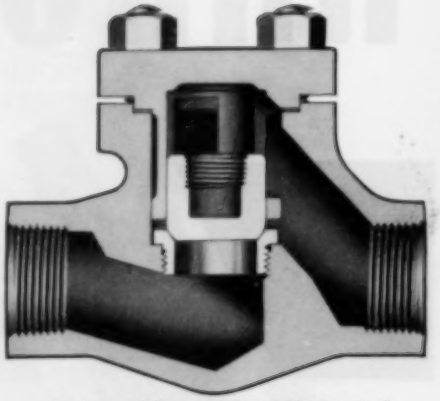
SMALL STEEL LIFT CHECKS WITH BETTER FLOW

Looking for small steel lift checks that don't chatter, and have extremely low pressure drop? Then specify these Crane 600-Pound Forged Steel Lift Checks. They have a patented cap-sleeve construction that provides high disc lift, even at low velocities, thereby eliminating destructive pounding and chattering. Special design of body contours and port openings give unusually low pressure drop.

Seats and discs are of wear-resisting Crane Exelloy. Rugged, forged steel bodies will withstand severe, high pressure services.

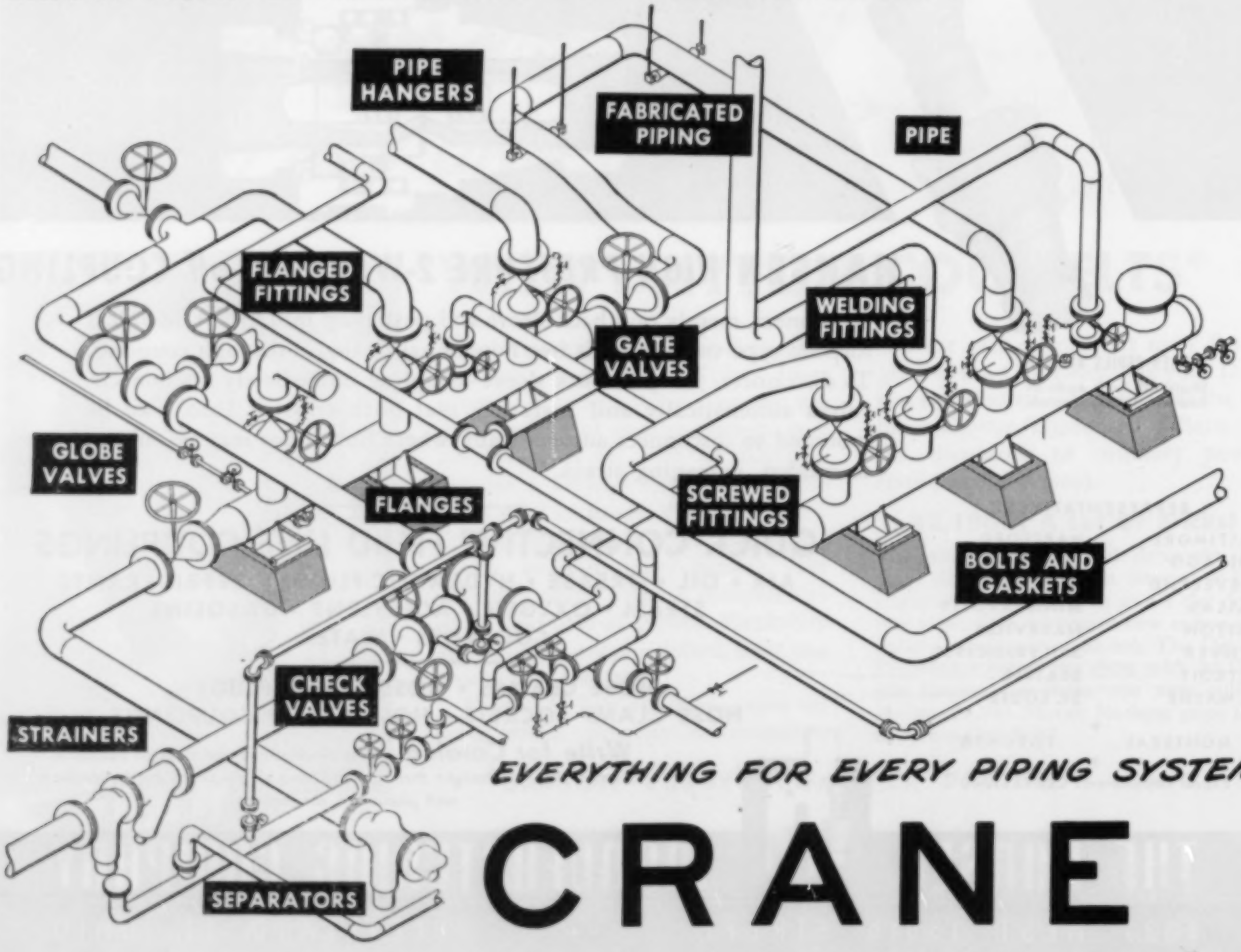
You can get these checks with union caps, screwed or socket welding ends, sizes ¼ through ¾ inches. Or with bolted cap, screwed, socket welding, or flanged ends, in sizes ½ through 2 inches. See your No. 49 Crane Catalog, pages 248-249.

CRANE CO., 836 S. Michigan Ave., Chicago 5, Ill.
Branches and Wholesalers Serving All Industrial Areas



600-Pound Forged Steel Horizontal Check with Bolted Cap. For steam, water, air, and gas up to 850° F.; for oil or oil vapor up to 1000° F. Sizes: ½ to 2-in. Screwed, flanged, or welding ends.

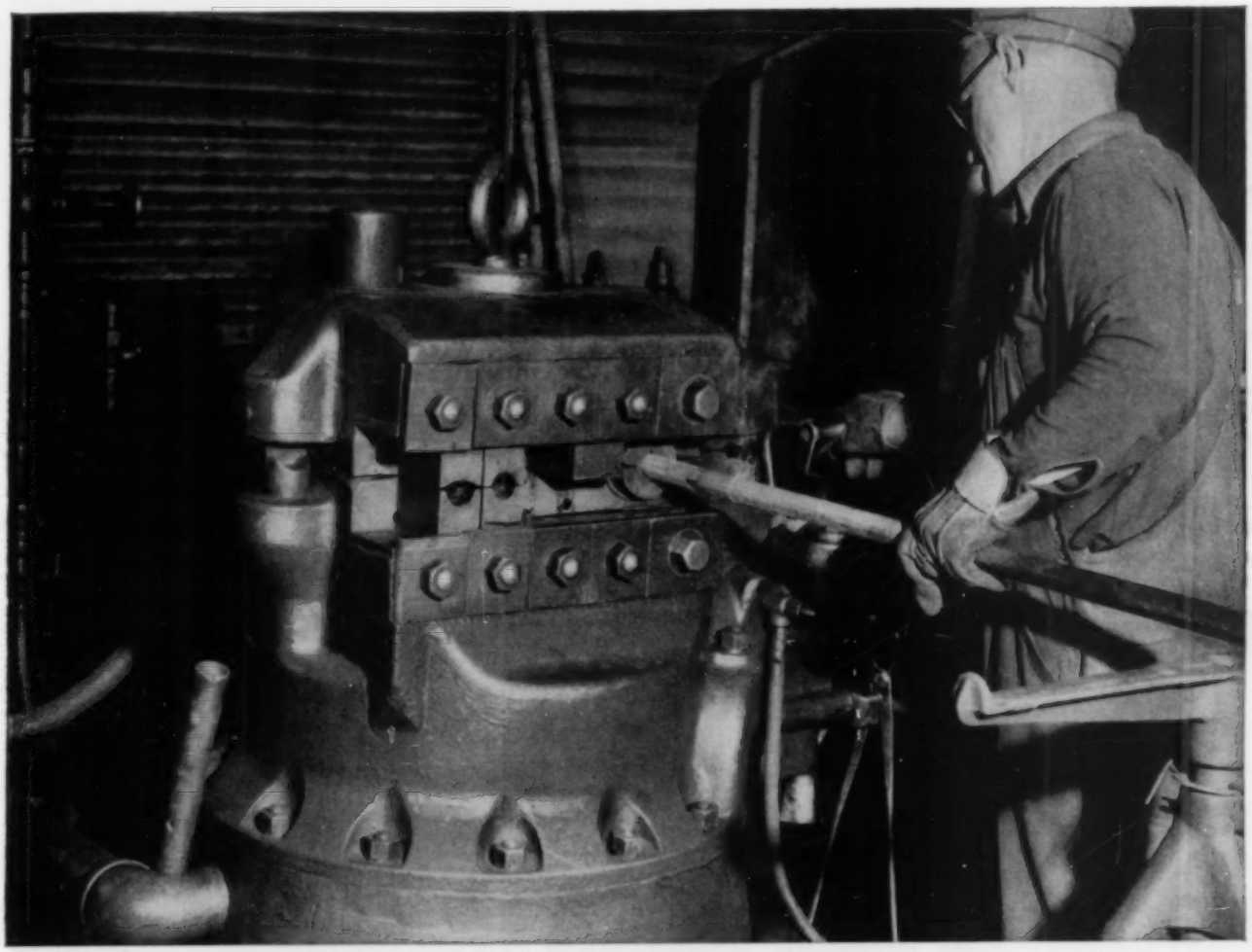
● THIS HIGH PRESSURE STEAM SYSTEM CAN BE 100% CRANE-EQUIPPED ... THROUGH ONE PURCHASE ORDER



EVERYTHING FOR EVERY PIPING SYSTEM

CRANE

VALVES • FITTINGS • PIPE • PLUMBING AND HEATING



Shanking Bethlehem Hollow at the site of a shaft-sinking project

Let *him* tell you

The sharpener operator can give you plenty of facts about Bethlehem Hollow Drill Steel. He'll tell you, for example, that it's ideal for either forged or detachable bits. He knows it's an easy steel to forge . . . and has a wide quenching range for trouble-free hardening. He'll mention, too, that the smooth center hole offers no starting points for fatigue failure.

The fine performance of Bethlehem Hollow is the result of careful manufacturing and inspection technique. Every bar is tough, fatigue-resisting steel with controlled hardenability and grain size. It's a steel you can rely on to keep costs at rock bottom.

Specify Bethlehem Hollow when you order steel next time. Prompt shipment from your converter or our mill.

SECTIONS AND SIZES

Hexagons	Rounds	Quarter-Octagons
⅞	⅞	⅞
1	1	1
1⅛	1⅛	1⅛
1¼	1¼	1¼
	1½	

Standard lengths up to 45 ft

BETHLEHEM STEEL COMPANY, BETHLEHEM, PA.
On the Pacific Coast Bethlehem products are sold by Bethlehem Pacific Coast Steel Corporation. *Export Distributor:* Bethlehem Steel Export Corporation.

★ BETHLEHEM STEEL ★

BETHLEHEM HOLLOW DRILL STEEL

Why these diggers can breathe easy about their air supply

THE diggers in the photo below are tearing up the old roadbed in the Holland Tunnel. They're working fast to get traffic back to normal in the 9,250-feet long twin tubes.

One thing they can count on is a steady flow of air for their hammers. The compressor is an Ingersoll-Rand, with its crankshaft mounted on Timken® bearings.

Timken tapered roller bearings on the crankshaft eliminate much of the risk of breakdowns, reduce maintenance time. They keep the crankshaft in positive alignment, minimize deflection and end-play. Wear on moving parts is cut, prolonging the life of the compressor. And because Timken bearings permit tighter closures that retain lubricants and keep out dirt better, lubrication is simplified.

Timken bearings carry all radial, thrust and combination loads because of their tapered construction. Line contact between rollers and races gives them extra load capacity. They normally last the life of the machine.

If you're looking for dependability, low-cost operation and long life in the machine you make or use, look for the trade-mark "Timken" on its bearings. The Timken Roller Bearing Company, Canton 6, Ohio. Canadian plant: St. Thomas, Ontario. Cable address: "TIMROSCO".

This symbol on a product means its bearings are the best.

INGERSOLL-RAND *compressor in Holland Tunnel. Its crankshaft is mounted on Timken bearings for dependable operation with less maintenance.*

FINISHED TO CLOSER TOLERANCES

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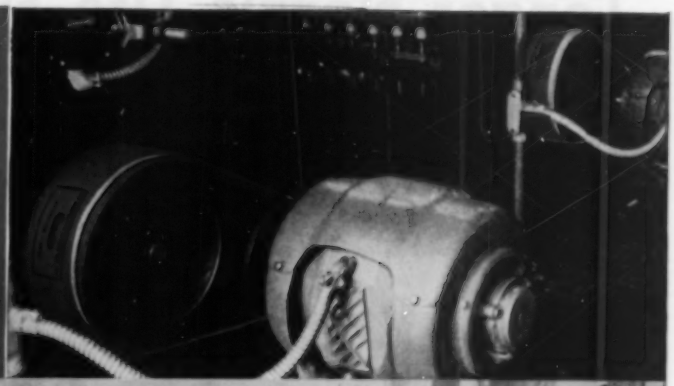

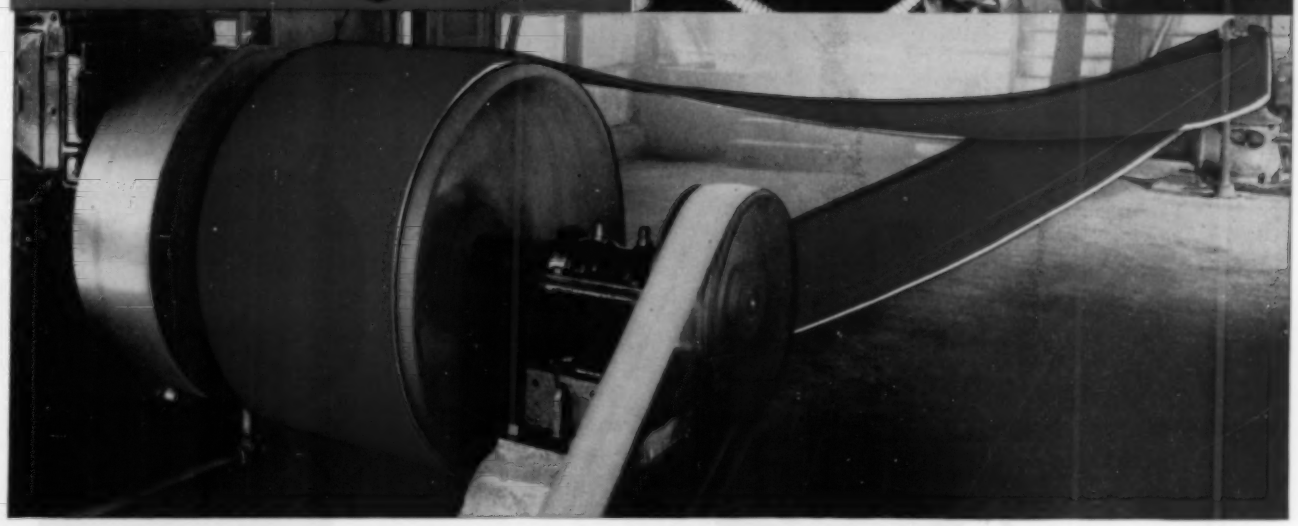

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JULY AND AUGUST ISSUES

BECAUSE of labor difficulties in the plant that prints our magazine we were unable to produce our July and August issues. These omissions marked the first break in regular monthly publication since the magazine was founded in 1896. To catch up with our schedule, this issue is designated as July-August-September. Expiration dates of paid subscriptions will be extended two months to compensate for the issues missed.

•

ON THE COVER

TO GUARD against car axles failing in service, American railroads prescribe rigid periodical inspection for the detection of flaws. This involves cleaning the axles, a preliminary operation that has heretofore been time-consuming and expensive. Our cover picture shows a machine, recently installed in the Cleveland shops of the New York Central Lines, that cleans an axle in 2½ minutes. The operator is shown turning a hand wheel that moves the brushes laterally. All the other work is performed by air power. A detailed description of the machine appears on Page 186.

•

IN THIS ISSUE

THE explanation for the fact that dogs sometimes howl or bark without apparent reason is that they hear sounds that are inaudible to the human ear. These high-frequency or ultrasonic sound waves not only can be made to perform parlor magic but they also have numerous known practical uses, with many more probably in the offing. Our leading article outlines the current state of the new science of ultrasonics.

•

CANADA is fortunate in having abundant sources of water power within easy reach of its largest cities, Montreal and Ottawa, and their contiguous important industrial areas. The Ottawa River system alone has a potential generating capacity of more than 2½ million horsepower, and several hydroelectric stations on this stream are now being added to those in existence. One immediate effect of these new plants will be to end power shortages that have impeded mining operations in several Ontario and Quebec districts during the dry seasons of the past several years. The first of four articles on these developments begins on Page 178.

•

SEAWEED is a source of several valuable commercial substances and its harvesting and treatment continues to be an important industry in the British Isles despite recent inroads made through the synthetic production of the materials obtained from it. Page 184.

•

MANY dollars worth of compressed air escapes through openings that are too small to be noticed. Any plant that uses considerable air would do well to check its entire distribution system occasionally to find out how leakproof it is. A method by which this can be done and which was employed by one industrial concern is described on Page 189.

Compressed Air Magazine

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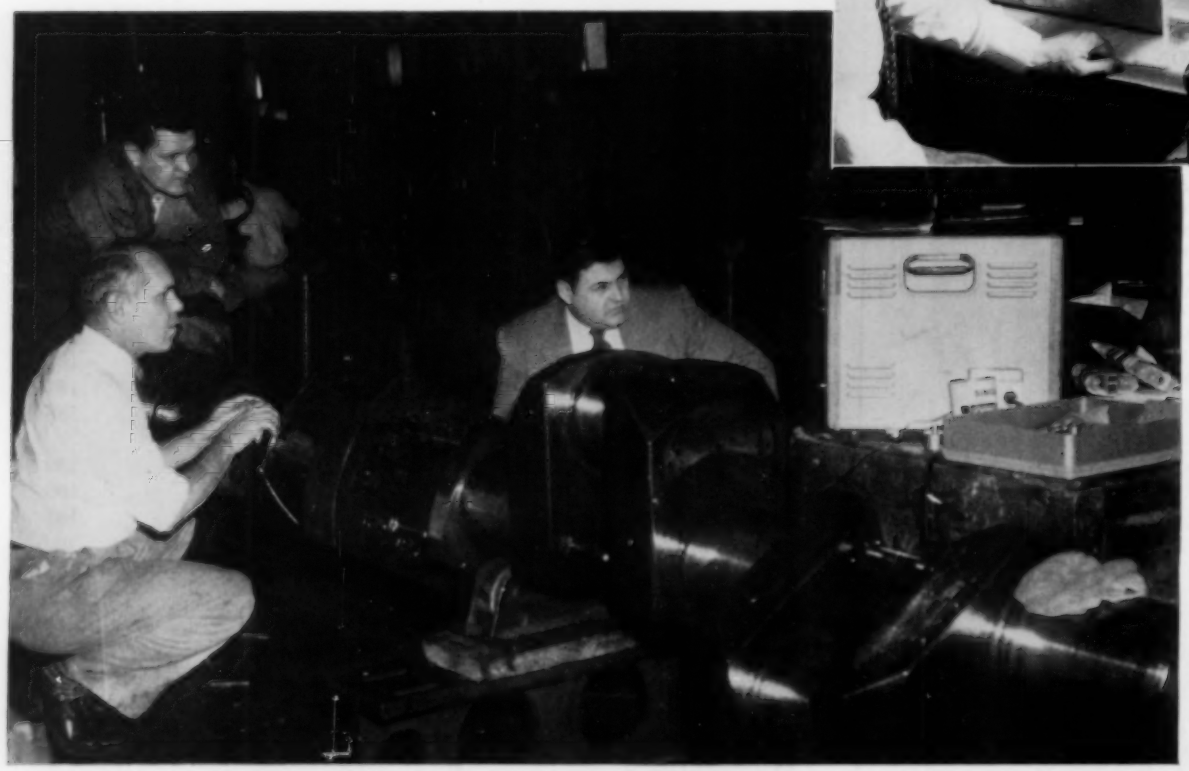
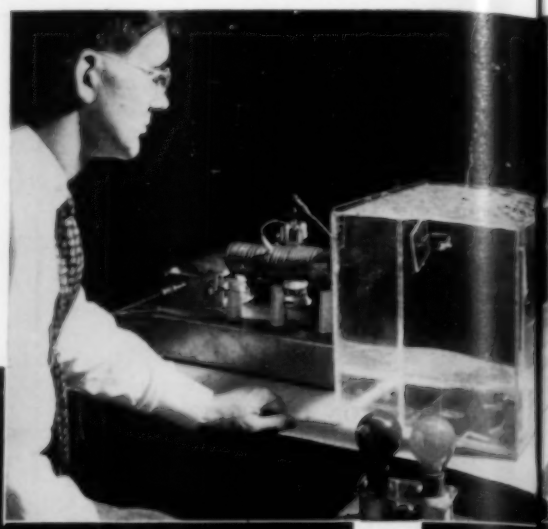
Magical Waves of Silent Sound

Ultrasonics, a New Branch of Science, Faces a Promising Industrial Future





LOOKING THROUGH A CRANKSHAFT

Representatives of the New York City firm of Sam Tours & Company, Inc., use ultrasonic vibrations generated by a Sperry Reflectoscope to search for defects in the crankshaft of a diesel engine. The vibrations pass through sound parts of the metal, but if they strike a flaw or other imperfection they bounce back to the transmitter and are indicated on the screen of a cathode-ray tube. The relative positions of these indications on the screen serve to distinguish between defects and intentional features such as oil holes, stud holes, etc., as well as to locate the defects in relation to the surface. With equipment of this kind one can spot imperfections in castings 30 feet thick.

NEWEST, most dramatic, and possibly the most important branch of science now being developed for general industrial use is ultrasonics, which is an integral part of the general science of acoustics.

The term ultrasonics generally is taken to mean sound waves that are pitched too high for the human ear to hear. Sound itself is nothing but a series of energy waves or vibrations that causes pressure pulsations in the medium in which it is traveling. The intensity of a particular sound—its pressure variation—is measured in decibels, zero decibels being the lowest audible level. The frequency or pitch of the sound, which is determined by the number of times the pressure increases or decreases in a unit of time, is expressed in cycles per second. Most persons can hear sounds having frequencies lying between 500 and 18,000 cycles per second, while those having frequencies of 20,000 cycles per second and up are ultrasonic.

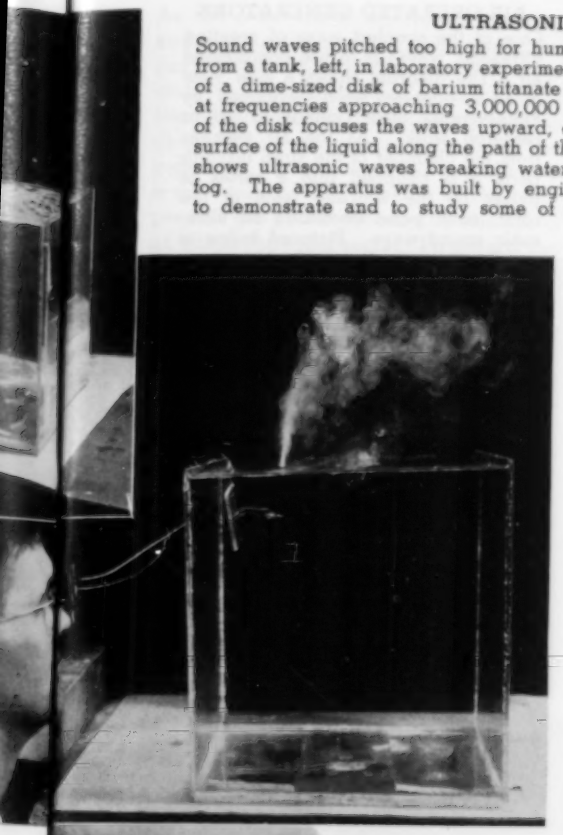
These high-pitched energy vibrations may be generated with many different types of equipment (at present compressed-air generators appear to be the most practical) for a number of unprecedented tasks such as the dispersion of immiscible liquids, the agglomeration of industrial-smoke particles, the location of flaws in materials that cannot be detected with X-rays, the destruction of bacteria, the stimulation of plant growth, and the production of unusual heating effects—all of which will be discussed presently.

Many ultrasonic phenomena have been known to scientists for more than a century; but, like electrostatics, the subject as a whole was for many years considered "theoretically beautiful and thoroughly impractical." At least one of the first investigations in this field was conducted by C. Despretz, a French physicist, in 1845. However, it is generally agreed that the subject branch of acoustical science lacked even a firm theoretical foundation prior to research work by Germany's Hermann Helmholtz and England's Lord Raleigh over a period of about 40 years in the latter part of the nineteenth century. As a matter of fact, no noteworthy uses for ultrasonic phenomena are known to have been suggested prior to World War I.

During the latter conflict, P. Langevin, another French physicist, endeav-

ULTRASONIC FOUNTAIN

Sound waves pitched too high for human beings to hear cause water to spurt from a tank, left, in laboratory experiments. Voltage applied across the terminals of a dime-sized disk of barium titanate suspended in the tank vibrates the disk at frequencies approaching 3,000,000 cycles a second. The concave surface of the disk focuses the waves upward, causing a jet of water to spring from the surface of the liquid along the path of the waves' emergence. The picture below shows ultrasonic waves breaking water into tiny droplets and dispersing it as fog. The apparatus was built by engineers of the General Electric Company to demonstrate and to study some of the curious properties of ultrasonics.

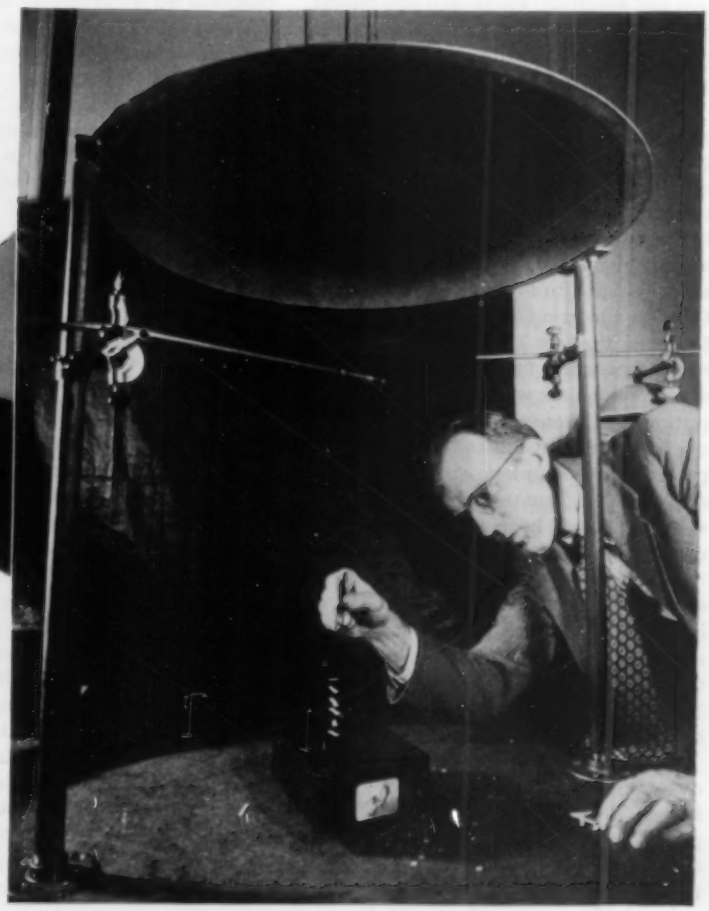


ored to develop ultrasonic equipment suitable for locating submerged German U-boats; but even that idea remained impractical until the first "Sonar" and "Radar" units were produced for World War II. Particular attention was focused on ultrasonics during that conflict by the striking success of the many devices that were developed to locate submarines, icebergs, sunken vessels, etc. Sonar waves, for instance, sent out through the water by a vibrating metal diaphragm attached to a ship's hull, could reach underwater craft miles distant. Reflected back to the ship, they were picked up by a receiver and converted into an electrical impulse that flashed a light on a dial to show how far away the submarine was. Therefore, when the war ended, men were tempted for the first time to explore the possibilities of ultrasonics for the purpose of creating new industrial products.

The results of these efforts have been extremely impressive, although it is still safe to say that not more than the surface of ultrasonic potentialities has been penetrated. Research has, in many respects, been limited to ultrasonic waves of lower frequencies and higher intensities, or higher frequencies and lower intensities, owing to a lack of satisfactory generators. As has already been said, many different types have been designed and tested; but, on the whole, they share one or more disadvantages such as high cost, inadaptability, and operational inefficiency—at least, in their present state of development.

For instance, crystal-type generators have been rather prominent in laboratory work because they are comparatively adaptable and useful when both high and low ultrasonic frequencies are required. However, in view of the fact that the operation of each necessitates the production of vibrations in a piezoelectric crystal (the crystal is energized by the terminals of a radio-frequency amplifier), output is normally of low intensity while cost is relatively high and efficiency leaves much to be desired. This is especially true where higher frequencies are needed, because much energy is lost in the majority of cases by submerging the crystal in a cooling oil bath to prevent heat damage.

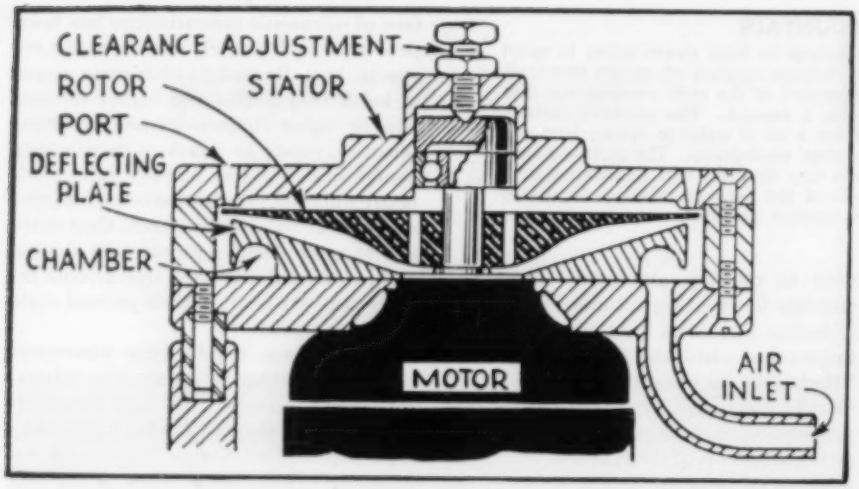
Magnetostriction generators, wherein electromagnets are energized by an oscillating current so as to vibrate ferromagnetic materials by causing rapid dimensional variations, have been inex-



PHOTOS, GENERAL ELECTRIC COMPANY

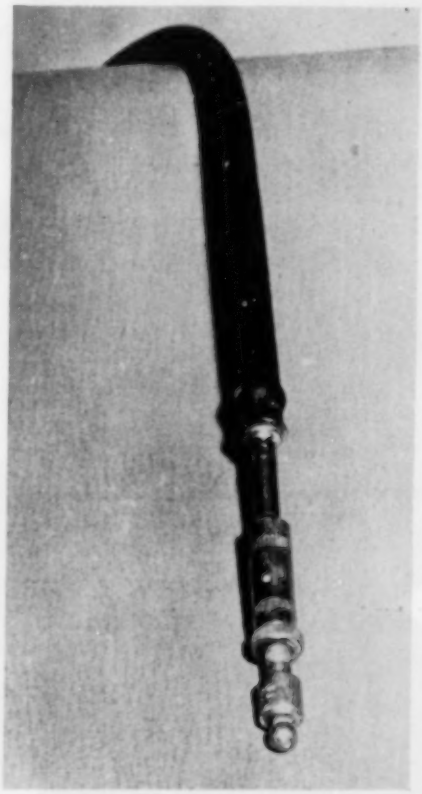
FEATS OF SILENT SOUND

Ultrasonic sound waves can do many seemingly impossible things. For instance, most persons believe that oil and water will not mix. But high-pitched sound waves passed through a test tube containing oil and water (above) create a mixture of minute droplets that will not separate for years. In the view at the right, bits of cork floating in midair are apparently defying gravity. They are supported by ultrasonic waves generated by a compressed-air whistle and reflected downward by a sheet-metal focusing hood. The little pieces are floating half a wave length apart above the point of high intensity.



AIR-OPERATED GENERATORS

One of the simplest ways of creating ultrasonic waves is to use compressed air. The diagram shows a side view of an air-operated siren developed by Pennsylvania State College to aid in research work. As the air escapes from the chamber of the siren through ports it is chopped into a series of pulses by the whirling teeth of the rotor, each pulse becoming an ultrasonic sound wave. Pictured below is an ultrasonic whistle attached to a compressed-air line.



pensively purchased as war-surplus Sonar equipment and used to produce ultrasonic waves of considerable intensity. But aside from the fact that these units probably cost more than crystal generators when they are new, they are subject to large heat-energy losses and more or less confined to a frequency output of less than 100 kilocycles.

Tuning forks are suitable for classroom demonstrations of ultrasonic phenomena, but individually they are incapable of developing more than a single frequency and must be energized by a generator of another type. Ultrasonic frequencies of 30 to 300 kilocycles have been experimentally produced by friction and electrical spark-gap equipment, but at this writing units in these categories appear to be nothing more than laboratory curiosities.

Most practical investigators are apparently of the opinion that the answer to the problem of ultrasonic generation will be found in compressed-air equipment, and in this connection encouraging results have been obtained, as previously suggested, although considerable work remains to be done. For instance, General Electric Company is one of the few firms that are known to have inaugurated a program for the development of a compressed-air whistle suitable for the purpose of generating ultrasonic frequencies and intensities. The whistle is probably the simplest and least-expensive form of generator that can be devised, and has been used in ultrasonic test work since 1883 when the initial "Galton pipe" was produced. However, it seems that most research engineers are inclined to believe that units of this type are limited to low frequencies and intensities. Reporting on the subject in 1949, General Electric's L. G. Osterman said in part:

"The whistle can be adjusted for frequency by varying the depth of the cylinder. This can be done by turning the piston adjustment screw. The whistle can be operated at any frequency above five kilocycles, which includes the ultrasonic range starting at 20 kilocycles.

"For best operation and maximum power output in the audible frequency range, the distance between the cylinder and the tube should be adjusted to give the loudest sound. At inaudible frequencies, sound can be felt as a pressure on the fingers and this pressure should be at a maximum value for optimum performance of the whistle. General Electric engineers have operated this generator at air pressures from 20 to 70 pounds per square inch with excellent results."

At this writing, sirens are apparently becoming the most prominent of all the ultrasonic generators. They can be operated with compressed air to produce acoustical waves as intense as 200 decibels and at virtually all frequencies including subaudio vibrations having frequencies of less than 10 cycles per second useful principally in laboratory work; audiosonic or audible vibrations having frequencies from about 10 to 20,000 cycles per second (at high intensities they can, in some respects, be used like waves of higher frequencies); and ultrasonic vibrations having frequencies of 20,000 or more cycles per second. These can be efficiently generated with less intensity and less power than audiosonic vibrations and for a comparatively great variety of purposes.

Operationally, the object of any siren is to eject a flow of air through a sequence of apertures so that it will be broken up into pulsations of a certain frequency and intensity. In the ordinary one-note unit, such as the audiosonic type that serves firemen, a manually controlled blower may be used simultaneously to create a flow of air and, by teeth or projections on its rotor, to break it up for passage through a perforated disk or plate. But in the case of the average ultrasonic siren it is desirable to produce waves of varying frequencies and intensities. This is done by keeping its housing under pressure and by either contrarotating two perforated disks or rotating a rotor adjacent to a stator, both perforated, by separate mechanical means so that the compressed air will escape from the siren as ultraintense or ultrahigh-frequency waves of predetermined quality or quantity.

Several English and Australian firms are reportedly making ultrasonic sirens of various types for different purposes, and a number of educational institutions such as the University of California at Los Angeles has used custom-built units for experimental work over a period of years. But so far as is known, only two American organizations—Ultrasonic Corporation of Cambridge, Mass., and G-B Brass & Aluminum Foundry, Inc., of Los Angeles—have developed ultrasonic sirens for commercial installation. The former was the first to start actual production, and the resultant equipment has been officially described by Harold W. Danser and Ernest P. Neumann, as follows:

"These generators consist of a rotor, facing a stator, with precision-matched ports around the periphery of each. A compressed gas is passed through the ports of the rotor and then of the stator.

As the rotor turns, alternately opening and closing the ports of the stator, the gas flows out intermittently through the stator ports. An intense sound wave is thereby created at the interface, and is directed by an acoustic horn from the generator. Intensity of the sound wave is governed by the pressure of the compressed gas and frequency by the speed at which the rotor turns. To govern the rotor speed, a variable speed motor may be used in conjunction with an autotransformer. About 225 cfm. of gas, compressed to 8 psi., gauge, are required to operate this generator; this gas flow may be obtained from a compressor requiring about a 10-hp. drive motor."

Incidentally, no special compressors have had to be provided for Ultrasonic Corporation sirens in plants that were already equipped with such units. For example, in Aluminum Company of America's factory at Vernon, Calif., a sufficient pressure for the operation of a siren of this kind was obtained without interfering with other pneumatic work by using a double regulator to reduce some of the 100-pound output pressure of a centralized Ingersoll-Rand compressor to a siren-input value averaging 10 psi.

Structurally, the G-B Brass & Aluminum Foundry siren is similar to Ultrasonic's generator except that the latter is designed for high-sonic intensities while the former seems to be more suitable for high-sonic frequencies. Dr. E. A. Alexander of the California Institute of Technology was responsible for the development of the G-B siren of which the components, excepting the steel drive shaft, are sand-cast of high-tensile manganese bronze. Included are a housing, a mounting ring, a stator, and a rotor, the last two being 16-inch disks perforated, respectively, with 120 holes each $\frac{3}{16}$ inch in diameter. The rotor is mounted on the drive shaft so that it can be rotated by a $3\frac{1}{2}$-hp. motor at speeds up to 12,000 rpm.

The completely assembled generator has an over-all length of 18 inches, a maximum outside diameter of 17 inches, and weighs 240 pounds. The purpose of the initial unit was to agglomerate factory-smoke particles in conformity with local smog-control regulations. It was successfully operated at frequencies averaging 20 to 22 kilocycles with a 310-cfm. I-R compressor, which was regulated for an output of 50 cfm. in order to maintain an internal siren pressure of only 5 pounds.

Considerable attention has been focused on the G-B siren, for, as Alcoa works engineer A. E. Huotari has pointed out, high-intensity generators are rather expensive for smoke-agglomeration purposes in large industrial plants. However, this does not mean that the Ultrasonic Corporation siren has failed to find important applications in such establishments. According to Dr. Clyde Berg of Union Oil Company's refinery at Wilmington, Calif., one of the latter type has served with success in connection with a new shale-oil retorting process.

"In the retorting of shales," Doctor Berg reports, "an appreciable portion of the oil produced leaves the unit as a mist in the gases drawn from the base of the unit. The character and extent of this mist also varies with the grade of shale being retorted. Fifty- to fifty-five gallon shales produce an effluent gas mixture containing a relatively small quantity of mist of large particle diameter which is readily agglomerated by the conventional blower equipment and is easily collected. Thirty- and seventy-gallon shales exhibit more appreciable mist formation in their retorting operation, and particles are of a relatively small diameter. This mist requires special handling; however, it is completely recovered in the combination Ultrasonic agglomeration and Roto-Clone collection equipment of the shale unit."

Considerable output intensity is apparently a necessity in virtually all industrial agglomeration generators because it would otherwise be difficult to propagate ultrasonic waves through large areas in a gaseous medium. However, frequencies appear to be dependent, in many respects, on the size or mass of the particles which must be agglomerated. For example, where the particles involved were of large dimensions (up to 10 microns) audiosonic frequencies as low as one kilocycle sufficed, whereas smaller ones have usually required higher frequencies.

In any event, many engineers maintain that the greatest advantages of ultrasonics will be realized through the use of vibrations of high frequencies (up to about 500,000 kilocycles) and low intensities (less than 100 decibels) because then it will be possible to concentrate the tremendous heat energy of ultrasonic vibrations (at frequencies of 300 or more kilocycles) without endangering operating personnel and without huge power

PHOTO, GENERAL ELECTRIC COMPANY

CRYSTAL GENERATOR

Shown here is an experimental unit that generates high-frequency sound waves from a quartz crystal. The latter is about the size of a hockey puck and is contained in a plastic case mounted on top of the unit's cabinet. When voltage is applied across the terminals of the crystal it vibrates, sending out sound waves. The glass chimney catches the spray of fluids that are placed in the center of the case and "boiled" by the ultrasonic sound waves.

losses, as well as to propagate ultrasonic vibrations in various solid or liquid mediums in accordance with the resonance values of the materials.

The high-frequency heat energy of ultrasonic waves was recently indicated by Norman Barnes of the General Electric Company in the statement that a kilowatt of ultrasonic power may be concentrated within an area a centimeter square, which is about ten times the energy concentration of a white-hot tungsten-lamp filament. Accordingly, it is rather difficult to discredit recent reports to the effect that British manufacturers have used ultrasonic-siren equipment to provide the heat that is required to weld and solder metals, including some of the new "superalloy" steels.

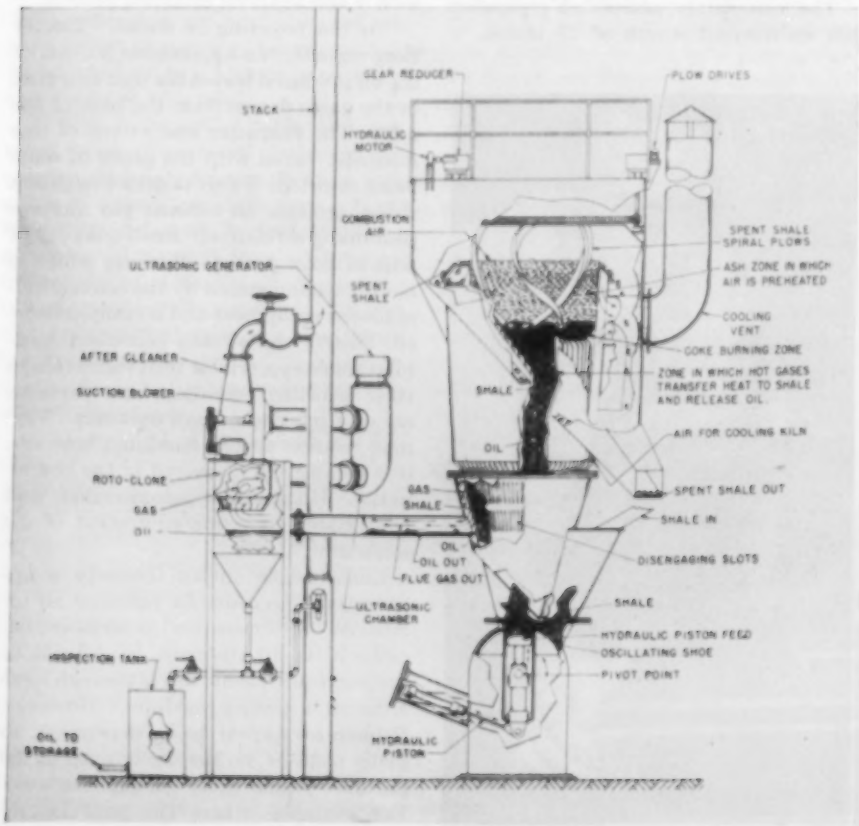
The usefulness of ultrasonic energy in connection with solid substances is well exemplified by resonance testing. This consists, briefly, in generating an ultrasonic "beam" at a frequency which depends upon the resonance of a solid so that the beam can be "bounced" through the material much the same as a ray of light penetrates and is reflected by a mirror. This technique is very helpful because it is possible thereby to compute the time it takes an ultrasonic impulse to bounce through a solid and thus indicate the presence or absence of flaws in the material. Further, the reflected impulse can be picked up for amplification like a radio signal to actuate a cathode tube. The latter resembles the picture-tube of a television set, except that its face is calibrated to permit the visual interpretation of the reflected signals, which vary with the nature of the internal structure that has delayed or accelerated their transmission.

Sperry Products, Inc., is believed to be the pioneer producer of ultrasonic "reflectoscopes"—resonance-testing equipment that has been used by companies such as Todd Shipyards at San Pedro, Calif., for the purpose of locating defects in alloy castings which were as much as 30 feet thick and which X-rays could not penetrate.

General Sound Company of Burbank, Calif., has developed an ultrasonic washing machine for commercial laundry work. It makes use of an ultrasonic generator or "transducer" to disperse vibrations with a resonance value suitable for sudsy water, and is said to do a much better job than conventional paddle machines in a fraction of the time and at a comparatively low cost. Recent news reports from Australia claim that an ultrasonic washer for home use has been invented there, but General Sound's chief engineer Jack Hibbard doubts that such a machine is practicable.

According to Frank Massa, director of Massa Laboratories, Cleveland, Ohio, the efficiency of washers of this type can be attributed to the power of ultrasonic vibrations to increase the wetting action of a liquid cleaning solution. And in this connection it is interesting to note that Massa has developed ultrasonic equipment for degreasing or cleaning industrial materials or products with standard chemical solutions. All this is of considerable importance because it reduces the cleaning time by a margin of at least 90 per cent.

Dr. Isadore Rudnick, physicist for the University of California, has utilized a pint-sized ultrasonic siren to kill small insects and rodents with varying degrees of success, depending upon the resonance or acoustical conductivity of the respective creatures. In consequence, he believes that exterminators of the future will substitute apparatus of this kind for poisons and traps.



CATCHING OIL-SHALE MIST

An oil-shale retorting plant developed and operated by The Union Oil Company at Wilmington, Calif., (right) uses an ultrasonic siren to reclaim oil escaping as a fine mist from the retorting chamber. The siren, manufactured by Ultrasonic Corporation, agglomerates the fine particles and makes it possible to recover them. The diagram shows construction and operational details of the plant.

INDUSTRIAL-MODEL SIREN

A. L. Goodreau, president of G-B Brass & Aluminum Foundry, Inc., demonstrates the controls that regulate the output of the air-operated ultrasonic siren developed for his company by Dr. E. A. Alexander of the California Institute of Technology. It has so far found use mainly in agglomerating fine particles of smoke, soot, dust, etc., but holds considerable promise in other fields.

Ultrasonic sirens have also served at the Navy Landing Aids Experimental Station near Arcata, Calif., to precipitate fog so that aircraft could land, but there is some room for doubt as to whether they will find wide application in this service because of the possibility of undesirable physiological reaction among bystanders. However, the Navy has made effective use of ultrasonic generators (designed by Bell & Howell Company of Hollywood) at the Naval Air Station near Los Alamitos, Calif., in producing "beams" which have enabled pilots to bring their flying machines down with safety regardless of obscuring smog or fog.

Further, investigators for the U. S. Department of Agriculture at Beltsville, Md., have reportedly done satisfactory work with ultrasonic vibrations in stimulating the development or germination of various seeds and tubers. And doctors at Princeton University's medical school are said to have experimented with ultrasonic equipment in an effort to find a remedy for internal diseases such as cancer which would normally require surgery.

Engineers at Woodwelding, Inc., Burbank, Calif., are currently looking into the potentiality of ultrasonic generators in connection with the dielectric molding or curing of plywood laminae. They are of the opinion that high-frequency vibrations will maintain the molecular alignment of wood veneers and plastic adhesives so that the latter can be heat-set without the difficulties incident to "steaming."

For the textile industry, Brush Development Company, Cleveland, Ohio, has produced ultrasonic equipment that can be used to accelerate chemical reactions (sometimes eliminating the need for conventional catalysts) to emulsify or disperse immiscible fluids such as water and oil and to speed up general operations like sizing and dying. Similarly, the new Industrial Products Division of Pillsbury Mills, Inc., Minneapolis, Minn., is reportedly mixing or processing food and related products with the aid of units of this type.

Battelle Memorial Institute of Columbus, Ohio, is said to have developed ultrasonic tools with which unprecedented tasks such as grinding and drilling ceramics can be readily accomplished. Among them are ultrasonic disintegrators with which the toughest materials can be broken down into particles that will pass through a 200-mesh screen in a few minutes.

At plants of the National Lead and American Steel & Wire companies, engineers have made use of ultrasonic vibrations to alloy metals such as copper and iron (this could not be done previously because their different melting points caused them to separate while cooling) and also to increase the homogeneity of cast alloys by providing the agitational energy necessary for the efficient "degassing" of molten metals. Chemists for Sherwin-Williams Paint Company are known to have resorted to ultrasonic generators in mixing new-type coating materials, while Seagram Distilleries likewise have availed themselves of the unique properties of "silent" sound waves in accelerating the chemical reactions involved in the making of aged liquors.

Other ultrasonic applications, which currently remain in the experimental stage, include the vaporization of liquids, the dispersion of metals in electrolytic operations, the drying of paper sheets in pulp mills, the homogenization of milk, and the making of stable photographic solutions. Many additional ones will no doubt be conceived and developed at an increasing rate, for there seems to be no doubt that most of the problems connected with the generation and use of ultrasonic vibrations are being solved.

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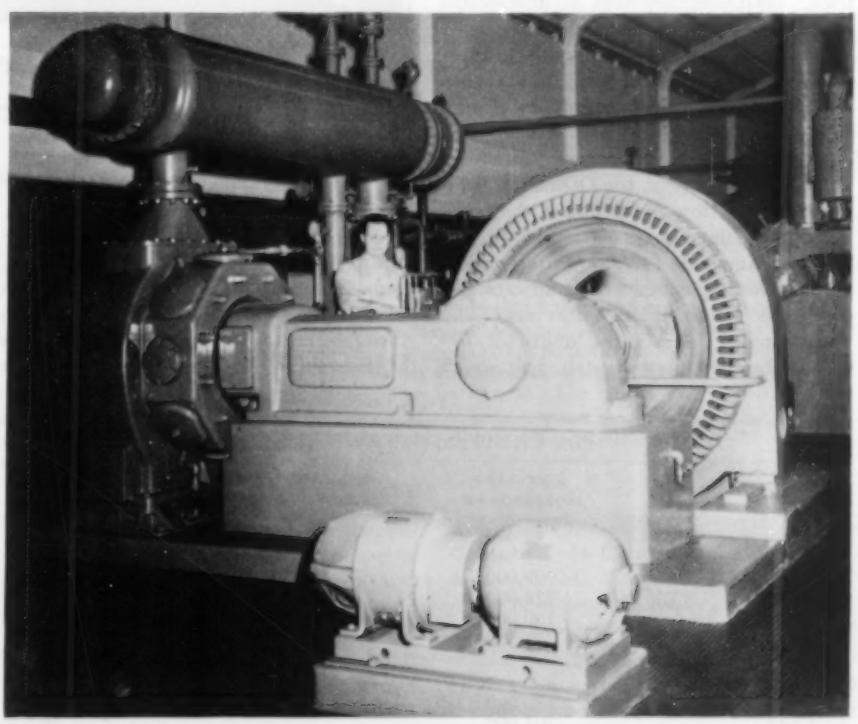


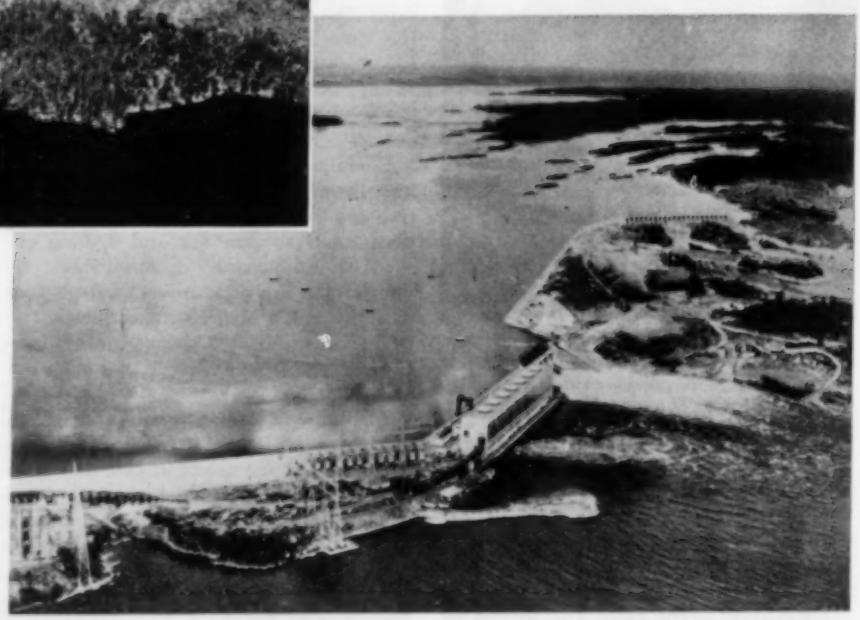
POWER FOR ULTRASONIC GENERATORS

The incorporation of air-operated ultrasonic apparatus in manufacturing processes does not involve the installation of additional sources of power if suitable centralized plant equipment is available. Units like this Ingersoll-Rand air compressor in the plant of C. F. Braun & Company, of Alhambra, Calif., have in several different factories eliminated the need of providing individual compressors for ultrasonic sirens.

Ottawa River Power Development

Low-Cost Electricity is Gradually Transforming the Economy of Central Canada

W. M. Goodwin



GENERATING PLANTS ON MAIN STREAM

The 81,000-hp. Bryson Station of the Gatineau Power Company at the left is located 66 miles upstream from the City of Ottawa. Approximately 30 miles below it is the Chats Falls plant shown above. The latter is owned jointly by the Hydro-Electric Power Commission of Ontario and the Ottawa Valley Power Company, Quebec. It has a capacity of 224,000 hp.

CENTRAL CANADA, devoid of coal, is fortunate in having an abundance of water power that can be harnessed at comparatively low cost. Partial use of the available energy has permitted the provinces of Ontario and Quebec to emerge during the past 50 years from a rather primitive economy, based mainly upon farming and lumbering, into a balanced economy in which natural resources contribute to substantial and varied manufacturing industries. Without low-cost hydroelectric power few of the industries would have been able to compete with products from outside sources, and the inhabitants would have remained purveyors of raw materials.

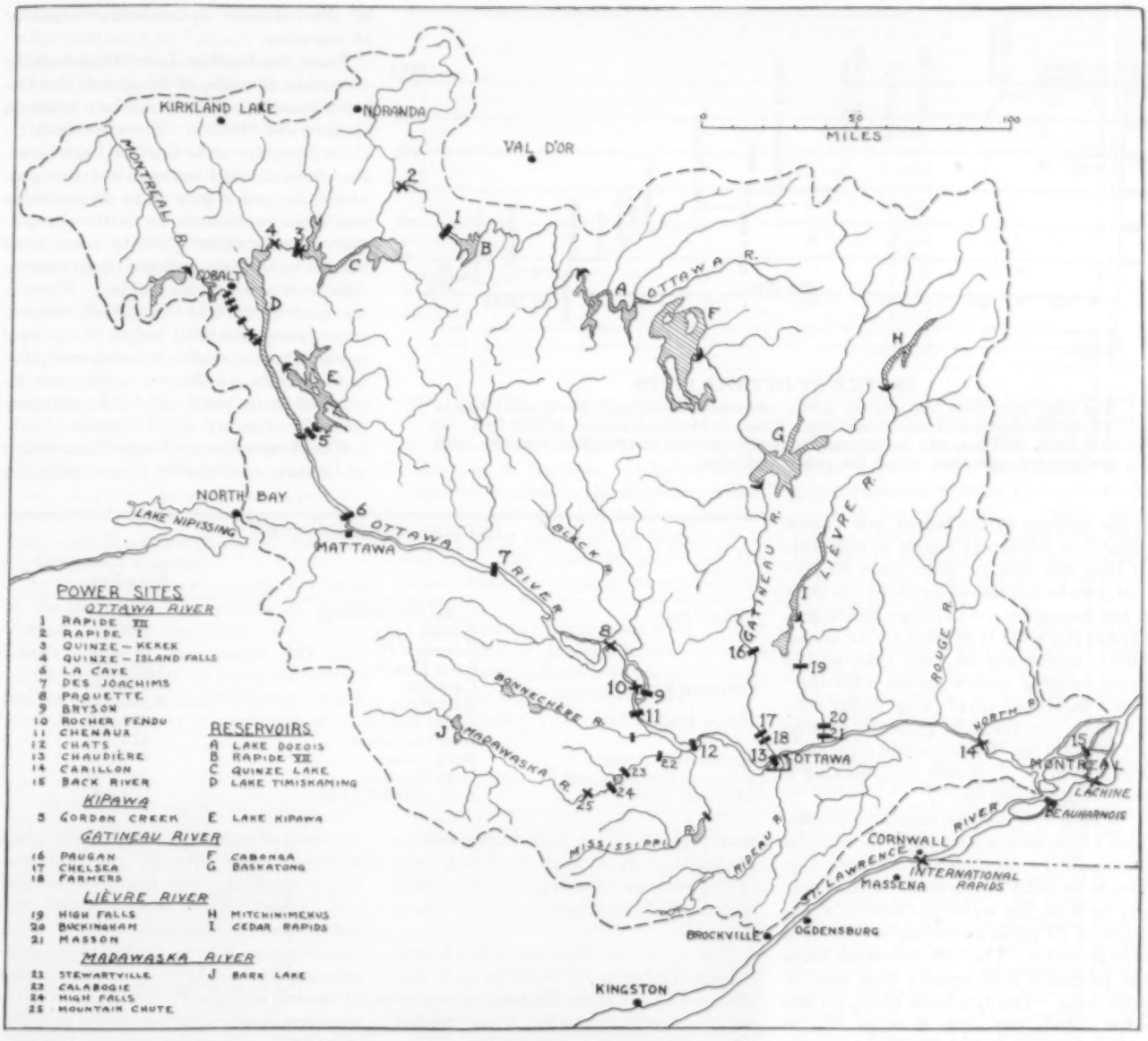
Among the rivers that are furnishing this wealth of power, the Ottawa holds a strategic position and is one of the more completely developed of the group. It taps a watershed of 60,000 square miles, the southern part of which adjoins old settled sections of the two provinces. The main stream has a total length of 700 miles. In the upper stretch, just south of the great gold-copper-zinc belt containing the Val d'Or, Noranda-Rouyn, and Kirkland Lake mines, the direction of flow is westward. Turning south through Lake Timiskaming it reaches Mattawa and the famous old canoe route originally used by the Indians and later by the early explorers and voyageurs in their travels toward the center of the continent. From Mattawa downstream to its junction with the St. Lawrence at Montreal, a distance of 300 miles, the river courses eastward, first through 100 miles of hills and woods and then through forests on the left and flat, fertile land on the right.

In the northeast corner of the watershed, where the famous old Cobalt silver camp is situated, is the southern lobe of the Great Clay Belt. In this area, a glacial lake of 40,000 years ago deposited clay or, rather, rock flour which now covers the surface so deeply that only the higher hills rise above it like islands in a plain. This district supports agricultural activities that are of some importance to the region's gold and copper camps.

Only about one-tenth of the Ottawa watershed is arable land. The remainder is a hilly area of lakes, rivers, and forests, the central part reaching an elevation of

POWER SITES, OTTAWA RIVER

Site	Installed Horsepower	Undeveloped Horsepower	Head Feet
Back River	45,000	—	22
Carillon	—	500,000	60
Chaudiere	109,000	50,000	40
Chats Falls	224,000	—	53
Chenaux	160,000	—	40
Bryson	81,000	—	
Rocher Fendu	—	200,000	65
Paquette	—	70,000	15
Des Joachims	480,000	—	130
La Cave	204,000	—	70
Quinze - Kekek	85,000	35,000	110
Quinze - Island Falls and Devil Chute	—	150,000	150
Rapide I	—	120,000	70
Rapide VII	64,000	55,000	70
	1,452,000	1,180,000	895



OTTAWA RIVER SYSTEM

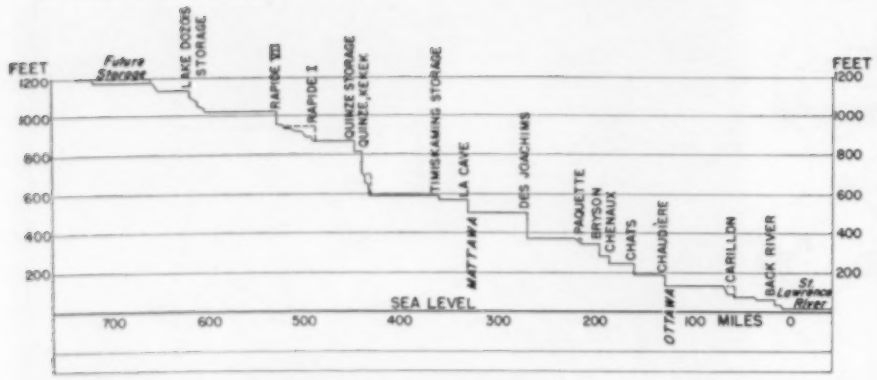
The main river is about 700 miles long. With its tributaries it drains 60,000 square miles of territory on which the annual precipitation ranges from 30 to 40 inches. The gradient of the stream system provides numerous sites for power development, and topographic conditions afford abundant opportunities for the creation of storage reservoirs to insure an even flow and, consequently, more or less continuous operation of turbines. Already, the river has been harnessed sufficiently to prevent floods in the lower reaches. When the plants under construction are completed, the installed generating capacity will be 1,452,000 hp. The potential capacity at undeveloped sites so far investigated is 1,180,000 hp., or a total of 2,632,000 hp., with some additional sites probably still available. The power is fed into a grid system that covers virtually all the industrial area radiating from Montreal and Toronto. The locations of the stations now in operation or under construction are identified by means of bars, and the undeveloped sites by crosses. The half-moon symbols indicate dams which have been erected to create impounding reservoirs for the purpose of stabilizing the downstream flow.

2000 feet. The lakes are rock-rimmed and provide natural reservoirs, some being of considerable extent. The topographical conditions also are the cause of abrupt changes in the streams, marked by falls and rapids where rocky banks usually offer fine locations for power plants. This combination of natural storage and power sites is an ideal one and gives the hydraulic engineer an excellent opportunity to practice his profession.

Lumbering in the primitive forests was the chief occupation in the Ottawa watershed for a century. With the tall timbers gone, pulpwood cutting became predominant. The region now maintains half a dozen large paper mills and can do so in perpetuity, provided a systematic forestry policy is adopted. One hundred miles of railway and a good road system make its southeastern section, the Laurentians, readily accessible to the million and a quarter people of Montreal. Starting within view of the city, this area, with its lakes and hills, is a vast winter and summer playground, somewhat like the Adirondacks in the United States.

With an annual precipitation of 30 to 40 inches, the Ottawa drainage basin is well watered. Swamps, lakes, and the forest floor provide good natural storage, and numerous sites have been found where inexpensive dams can impound large volumes of water from the spring runoff. This artificial storage is already materially increasing the natural minimum flow, particularly on tributaries such as the Gatineau, Lièvre, and Madawaska.

The total drop from the forebay of the uppermost developed site, Rapide VII,



PROFILE OF OTTAWA RIVER

The total drop from the forebay of the uppermost developed power site, Rapide VII, to the tailrace of the lowest, Back River on Montreal Island, is 986 feet. Of this head, 895 feet can be utilized by continuing the construction program until stations are operating at all the points indicated.

to the tailrace of the lowest one—Back River—on Montreal Island is 986 feet. Of this, 895 feet, or more than 90 percent, can be harnessed by using the head at fourteen points. At Rocher Fendu and Bryson the river is divided by an island with a power site on each side, so the accompanying profile shows only thirteen. Including plants now under construction, the installed capacity at nine is 1,452,000 hp. Undeveloped sites have a potential of 1,180,000 hp., making a total of 2,632,000 hp.

As indicated on the plan and profile, most of the power sites have substantial impounding reservoirs above them. The dam to be built at Carillon, for instance, will back up the water to Ottawa, a distance of 70 miles averaging well over a mile in width. The Des Joachims Dam has formed a lake equally wide and 50 miles long. The Chenaux Dam, on the other hand, has only 8 miles of the widened river behind it. The large amount of water immediately available in most of these nearby storages permits great flexibility of plant operation. For example, full operation of the Chats Falls station for about ten hours a day lowers the forebay from 9 to 10 inches. During the night only one or two of the eight units are kept running and the forebay level rises again to its regulated maximum.

Control of the Ottawa's annual flow is still far from complete, although three large reservoirs on the main river are now in use, as well as others on tributaries. These have already increased the minimum flow at the upper sites to an appreciable extent, while their effect on the lower ones—those below the large regulated tributaries—is still more pronounced.

From his home at Ste. Anne de Bellevue, at the west end of Montreal Island, the writer has for years observed the results of this control. Two decades ago, at the Rapids of Ste. Anne's, the water came down in the spring with a mighty roar and the river was impassable to navigation. Now, high flood is a thing of the past, and the crests of the rolling waters are barely broken by the spring flows.

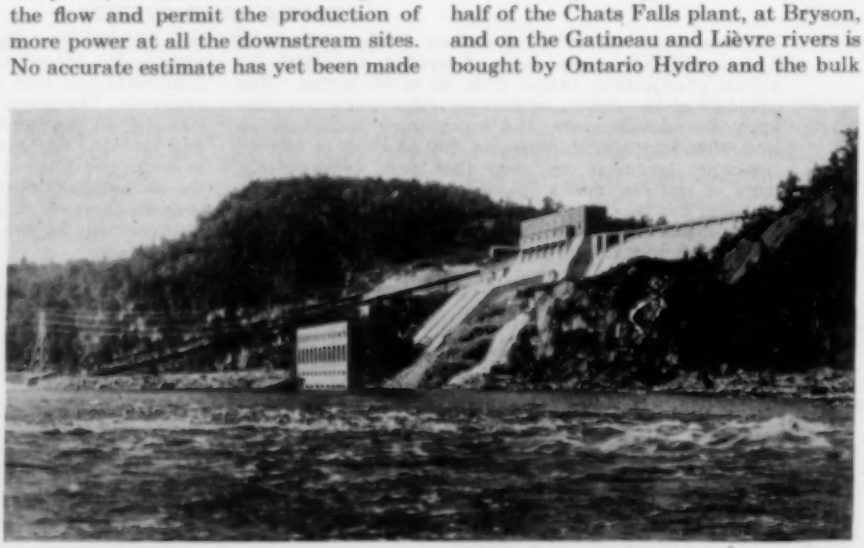
Two additional areas suitable for large storage basins have been located near the headwaters of the Ottawa, and others will doubtless be found when needed. They will, of course, still further regulate the flow and permit the production of more power at all the downstream sites. No accurate estimate has yet been made of the ultimate hydroelectric capacity of the river.

From the head of Lake Timiskaming to within 40 miles of Montreal, the Ottawa constitutes the boundary between Quebec and Ontario. The sites from La Cave downstream to Carillon have therefore been divided between the two provinces in such a way as to be equitable and most convenient for both. In general, those nearer Toronto have been alloted to Ontario, and the ones closer to Montreal are held by Quebec. There is an equal division at Chats Falls where a powerhouse was built before the general agreement was made. Another exception is Chaudière, at Ottawa, which was developed many years ago by six companies with as many small stations.

The Hydro-Electric Power Commission of Ontario is virtually a monopoly, for it owns and operates nearly all the larger water-power plants in the province. Many small ones still belong to municipalities and private interests, but their total output is inappreciable. Second to the Niagara River, the Ottawa is at present Ontario Hydro's largest source of electric energy. Its importance to the province is accentuated by the fact that most of the power generated in Quebec's half of the Chats Falls plant, at Bryson, and on the Gatineau and Lièvre rivers is bought by Ontario Hydro and the bulk

PRINCIPAL RESERVOIRS

		Storage Capacity Acre-Feet
Main River	Lake Timiskaming	826,000
	Quinze Lake	992,000
	Rapide VII	401,000
	Lake Dozois	1,680,000
Gatineau River	Cabonga	1,050,000
	Baskatong	2,160,000
Lievre River	Cedar Rapids	425,000
	Mitchinimekus	425,000
Madawaska River	Bark Lake	300,000
Kipawa (Gordon Creek)	Lake Kipawa	562,000
Montreal River	Lady Evelyn Lake	73,000



HIGH FALLS STATION

This 120,000-hp. plant is one of the three on the Lievre River that are owned by the MacLaren-Quebec Power Company. It operates under a head of 180 feet. The current produced there is used chiefly in a large pulp and paper mill located at Masson, Que.

of it is transmitted at 200,000 volts 200 miles westward to Toronto and vicinity. Only a small percentage is required to serve the paper mills, factories, municipalities, and farms of the Ottawa Valley.

Quebec has only recently adopted the idea of public ownership of power, and a large part of the business is still in private hands. In the Ottawa watershed, the uppermost plant at Rapide VII was developed under provincial ownership and is now operated by Quebec Hydro to serve the Noranda mining area. Quebec's half of the Chats Falls powerhouse, and the Bryson, Chaudière, Gatineau, and Lièvre stations are all owned by private companies. It seems likely, however, that the large Carillon and Rocher Fendu projects will be undertaken by public authority. But work on them will probably not be started for some time to come because Quebec has about two million undeveloped horsepower at Lachine and Beauharnois on the outskirts of Montreal.

As has already been mentioned, most of the electricity now generated on the Ottawa, Lièvre, Gatineau, and Madawaska rivers is transmitted 200 miles to Ontario's center of industry around the western end of Lake Ontario. While most of the current is consumed in this area, actually one great system of lines covers the whole southern part of the province from the Quebec border 500 miles west to Windsor. An interconnection is to be made in the near future with the extensive network that supplies the great mining region of the North. It is into this vast common pool that the power from the Ottawa watershed will be fed.

All Ontario's remaining sites on the Ottawa are at present under development. Des Joachims is expected to have four of its eight 60,000-hp. units in operation during 1950, and the remainder early in 1951. Chenaux is to be put in service during 1951 and La Cave in 1952. Thus, before the end of 1952, Ontario Hydro should place 844,000 hp. of new power from the Ottawa River at the disposal of its customers. These undertakings, by the way, cover only about half the Commission's present construction program, which includes two auxiliary steam plants.

The fact that the three large Ottawa sites just referred to are being developed simultaneously, in addition to those on other rivers farther west, calls for an explanation. During World War II, power facilities were taxed to the utmost, but work on new projects was necessarily postponed because all the authorities fully expected that cessation of hostilities would be accompanied by a decided letdown of industry that would restore Ontario's prewar comfortable surplus of hydroelectric energy. In place of the slump came a boom, and the demand for power was soon considerably in excess of the wartime peak. The result has been a 3-year shortage that is soon to be relieved by the completion, among others, of the Chenaux, Des Joachims, and La Cave projects. Descriptions of their engineering features will be given in succeeding articles.

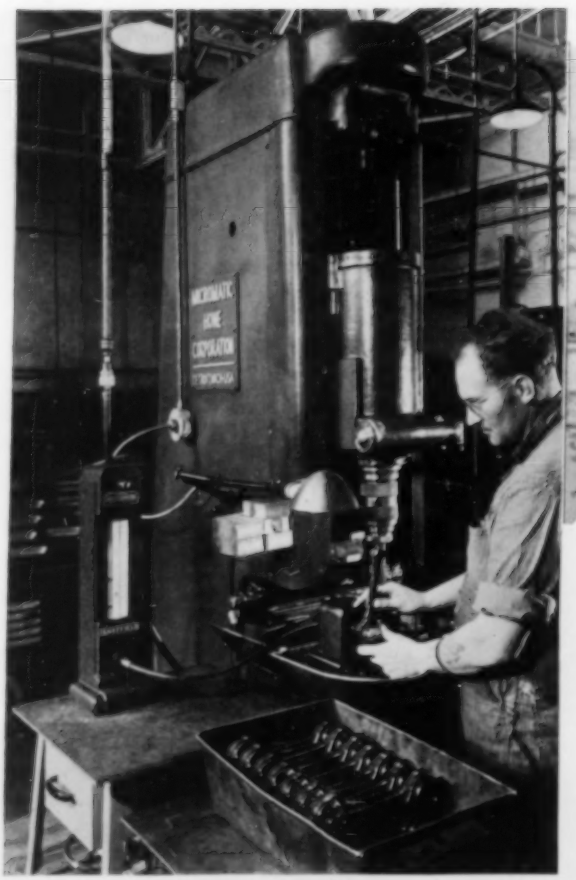
TRIBUTARIES OF OTTAWA RIVER

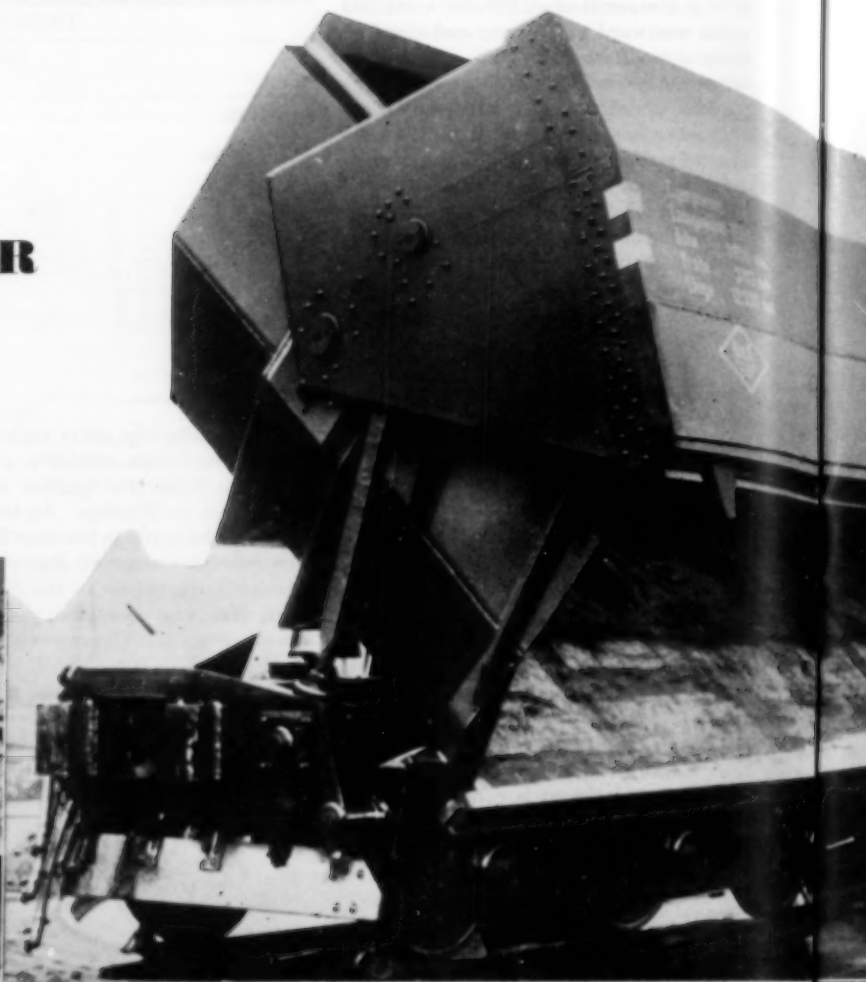
	Developed Sites	Developed Horsepower	Undeveloped Horsepower
Gatineau	3	528,000	—
Lievre	3	273,000	—
Madawaska	3	147,000	40,000
Montreal	5	31,000	30,000
Kipawa	1	24,000	—
North	3	10,600	—
Rouge	2	8,800	—
Rideau	2	4,400	—
Mississippi	3	6,800	—
Bonnechere	2	2,300	—
Black	2	6,600	—
Mattawa	1	1,100	—
		1,343,600	70,000

GATINEAU RIVER DEVELOPMENTS

Seven miles above the junction of the Gatineau and Ottawa rivers are the Chelsea and Farmers plants of the Gatineau Power Company pictured at the right. Their combined capacity is 290,000 hp. The Farmers Station is in the foreground. The other view shows the same company's 238,000-hp. plant at Paugan Falls 23 miles farther upstream.

COMPRESSED AIR AT WORK

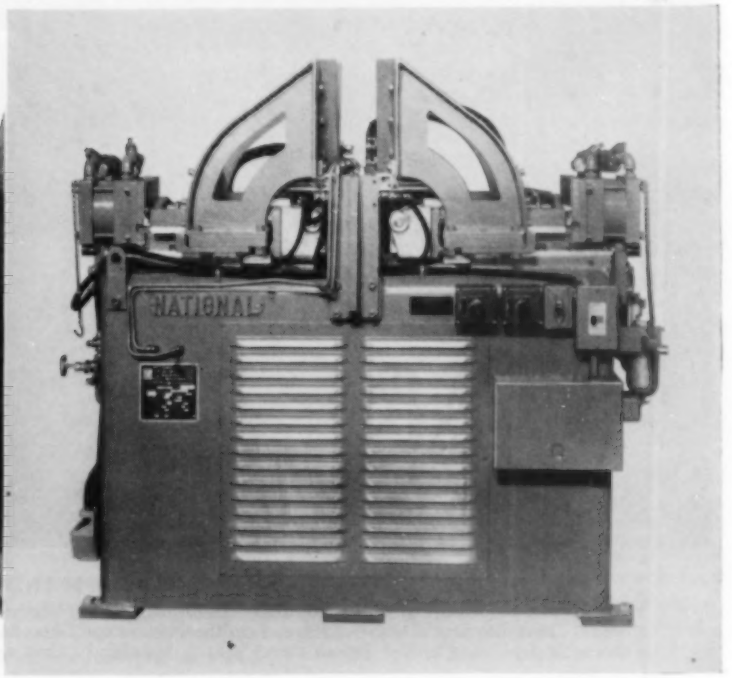




In the Harley-Davidson Motor Company plant at Milwaukee, Wis., motorcycle connecting-rod bearings are checked instantly and accurately to within one ten-thousandth inch with the Sheffield Precisionaire flow-type air gauge shown mounted at the left of the honing machine in the picture above. Seven other Sheffield air gauges are used for checking thirteen dimensions of essential parts. By eliminating error and reducing spoilage, these measuring devices improve the quality of the final product and cut manufacturing costs.

WIDE WORLD PHOTO

Cars that are dumped by the action of air cylinders have long been used, especially in the mining and construction fields. Now the German firm of Orenstein & Koppel has introduced a full-size boxcar (left) that embodies an additional feature. As it is being tilted, one side member is automatically raised to facilitate discharging. The car was designed as a grain carrier and has a capacity of approximately 118 cubic yards. By merely connecting an air hose and turning a valve its load can be dumped in a few seconds.



In the manufacture of stainless-steel knives and forks, hot upsetting of the rods from which they are formed is essential so as to redistribute the metal and obtain the desired thicknesses at certain points prior to forging. To perform the work of upsetting, National Electric Welding Machines Company, of Bay City, Mich., has designed the machine shown above. In it, each rod is heated electrically, then upset near both ends by the action of opposing air-operated cylinders. The operator only keeps the supply hopper loaded with rods; the machine feeds, upsets, and ejects them automatically. It processes 800 rods an hour, thus providing sufficient forging stock to make 1600 knives or forks. The first two machines are now in service in one of the nation's leading cutlery plants.

●

The tail gate of each Studebaker truck bears the company name in embossed white-enamel letters, 4⅜ inches high, that are sprayed on through a metal stencil. Air-operated clamping fixtures enable one operator to apply the coating fast enough to keep pace with the assembly-line movement of 25 vehicles an hour. In the first of the two pictures at the left he is shown turning a valve that admits air under 45-50 psi. pressure to two 1¼-inch cylinders which hold the stencil firmly in place on the opposite side of the tail gate. A quick-acting connector simplifies hooking up the air line, and a spring balancer suspended from an overhead monorail relieves the operator of muscular effort in handling the heavy mask assembly. In the near picture he is doing the spraying. After being used five or six times, the stencil is cleaned by soaking it in a tank of denatured ethyl acetate for a few minutes, scrubbing it with a fiber brush, and drying it under a suction hood. With three assemblies on hand, one is in use while the second is soaking and the third is drying.

PHOTOS FROM ALGINATE INDUSTRIES LIMITED

HAY FROM THE SEA

A seaweed processing plant in the Outer Hebrides, Scotland. There the raw material gathered on the gale-swept shores is dried and milled before being sent to mainland factories for further treatment. The actual method of extracting the useful chemical constituents is a trade secret, but various substances are obtained.

Seaweed — the New Provider

Marine Growth Is the Basis of an Extensive United Kingdom Industry

Arthur Nettleton

FABRICS, pharmaceutical preparations, paints, rubber substitutes, polishes, paper, ice cream and foodstuffs are just a few of the things now being made from or with the aid of seaweed which litters the coast of the United Kingdom. To fully appreciate the importance of this development it should be realized that only fifteen years ago most of that country's seashore wealth was going to waste. Some varieties were regarded as edible in certain localities, and others were being harvested for their iodine; but beyond that the humble marine plants were looked upon as valueless.

Science and the war have changed all that, and a big future is forecast for one product from Britain's brown seaweed alone. The latter yields alginic acid or agar-agar, a substance that already has a long list of applications. Our grandparents knew it as isinglass and used it as a preservative and for cooking. Before the conflict, the demand for it was on the increase because test chemists found that it served them well when they needed a jelly capable of remaining solid under all conditions.

But prior to 1939, the only big supplier was Japan. She did a world-wide trade in alginic acid obtained from Ceylon moss harvested in her waters, selling at the rate of more than nine million pounds a year to some European countries and exporting equally big weights to the United States and Canada. When the war lords of Nippon sided with the Nazis and deprived Britain of agar-agar, the blow was a serious one. That's why the government immediately appointed experts to investigate her own seaweeds. Vast beds were located by aerial photography, and specimens were collected for laboratory tests at Edinburgh and elsewhere. At a research station on the Isle of Man other experiments were made to determine, among other things, just how fast each of the different species grows. Even records of old customs were consulted. It was learned, for instance, that Scottish Lowlanders chewed a seaweed called dulse long before chewing tobacco was known. So quantities of it were gathered and tested to ascertain just what properties made the stuff chewable.

The Ministry of Supply eventually set up a Scottish Seaweed Research Association to probe still further into the mysteries of marine vegetation and to put it to use. The discoveries made have been astonishing. More than a score of industries have found applications for them, and some new ones have been established as a result of the experiments. At Leeds University, for example, a seaweed extract has enabled its textile department to weave wool into fabrics of a far finer texture than was hitherto thought possible. In the past, the limit of fineness for practical purposes was governed by the breakage point of the threads in the looms. Ultrathin yarns were liable to snap in the machines and produce cloth with imperfections. Today the finest threads can be made temporarily strong by giving them an alginic coating. After the material has been

woven, the extract is washed off, leaving a pure-wool fabric of extreme lightness and beauty.

Another novel product from seaweed is soluble yarn which serves a very useful purpose in the hosiery industry. Socks have long been knit in a continuous length and then separated by unpicking them at the joints. By the present method, which is much easier and quicker, a few rows of soluble thread are knitted in at the toes and tops and simply dissolved. Then, too, glamorous stockings and diaphanous lingerie are being fashioned from lustrous rayon filaments spun from a mixture of algin and metal. This material is fireproof and waterproof and offers great possibilities also as a fabric for curtains, for upholstering, etc.

The prospects of the increasing use of alginates in the textile industry are so promising that the British Government is building more factories in Scotland for processing seaweed. South Ulst, one of the Outer Hebrides group of islands, had the first drying and milling plant for tangleweed deposited on beaches by Atlantic storms. Thousands of tons of seaweed have gone from there and northern Ireland, which is another prolific source of the raw material, to mainland factories for the extraction of the valuable alginates.

Seaweed that grows between the low- and high-water marks is easiest to harvest. Gathering starts at high tide, the plants being forked into nets as the water recedes and leaves it on the shore. A single reaper may harvest fifteen hundredweights in an hour, though the average rate is about ten an hour. The filled nets are then floated to a point for collection and carting to the processing factory. Gathering seaweed that is never uncovered by the tide presents a bigger problem, but the difficulties are being overcome with the help of the Engineering Division of the Institute of Seaweed Research.

At Oban, Scotland, grappling irons, which tear the plants from the sea bed in 2-yard strips, have been tried out, and now a continuous grapnel attached to a moving belt is undergoing tests. Another idea is a device fitted with rotating knives that can be lowered from a boat. To promote this phase of the work an experimental tank has been built at Inveresk Gate, Musselburgh; and, in conjunction, efforts are being made to ascertain whether seaweed that is readily harvested can be introduced anywhere along the coast of Britain. In the Pacific Ocean there are giant floating varieties that can be gathered easily. So spores have been obtained, and attempts are being made to cultivate them in Scottish waters. If they are successful, seaweed farms may become a reality.

Basically, the methods by which the alginates are extracted from seaweed involve digestion by sodium carbonate or a hydroxide solution, followed by precipitation of the resultant alginic acid by means of a mineral acid. The processes by which these operations are performed, and which are directed mainly towards purifying the product, are secret (most of them are patented). Sometimes bleaching and filtration are resorted to, and the weed may be given a preliminary washing to recover soluble by-products such as iodides. Alcohol is often used to facilitate the removal of water and impurities from the freshly precipitated alginic acid. The latter looks like finely ground oatmeal when dry, but when mixed with water it becomes a pure white jelly with exceptional cell-forming properties.

In addition to its applications in the textile field, alginic acid has pharmaceutical value, meeting a need in bacteriological research and serving as a surgical dressing. Hospitals use it widely, and in dried and powered form it is taken as a protection against goitre. The medical world has recently made a discovery that promises to add still further to the importance of seaweed. It has been found that haemorrhage can be stanched by means of a soluble wool made therefrom. So far the tests have been confined to dental operations, in which the "wool" has proved its worth. Now those responsible for that development are concentrating on ways of applying it so as to make surgery bloodless.

The soap, paint, aniline-dye, and synthetic-rubber industries are hopeful of finding increasing uses for marine vegetation through laboratory work. Alginates have already been vulcanized the same as rubber and converted into typewriter rollers and similar articles. Still another product of seaweed is a transparent and particularly tough kind of paper. It also provides a flavoring for ice cream and a thickener for soups. Oddly enough, the extraction of iodine from kelp, which was one of Britain's earliest commercial uses of seaweed, is no longer important. Most of it is now obtained as a by-product in the purification of Chilean sodium nitrate. However, kelp, one of the coarsest varieties of seaweed, still serves the glass manufacturer.

A new chapter is being added to the romance of seaweed nearly every day. A most promising avenue lies in the recent discovery of a constituent that has been named lamarin. Just what its merits are is still uncertain; but judging by past experience, it will soon be added to the long list of extracts which come from the plants of the sea.

Surveys of the beds around the shores of Britain show that there is never likely to be a shortage of the most useful species. To ascertain just where they grow, a research ship, the *Prospecto*, was fitted out for the purpose with special harvesting gear as well as with a pressing, drying, and milling plant. More than 250 distinct varieties have been identified and carefully classified, and another government chemistry division has investigated their seasonal organic and inorganic constituents.

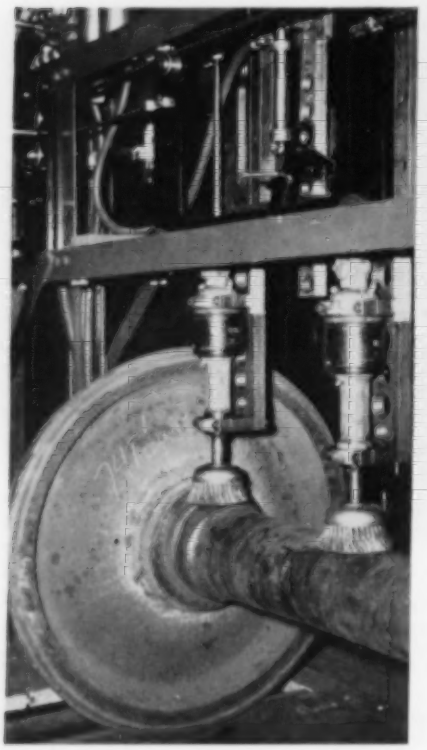
The Research Association is of the opinion that seaweed can create an industry worth at least $75,000,000 a year. The present and potential schemes of harnessing Scotland's lochs and fast-moving rivers to supply cheap electric power are expected to encourage the establishment in that part of Britain not only of seaweed processing and extraction plants but also of factories that will need their products. Already, two hosiery firms have built weaving mills there based upon the use of alginates.

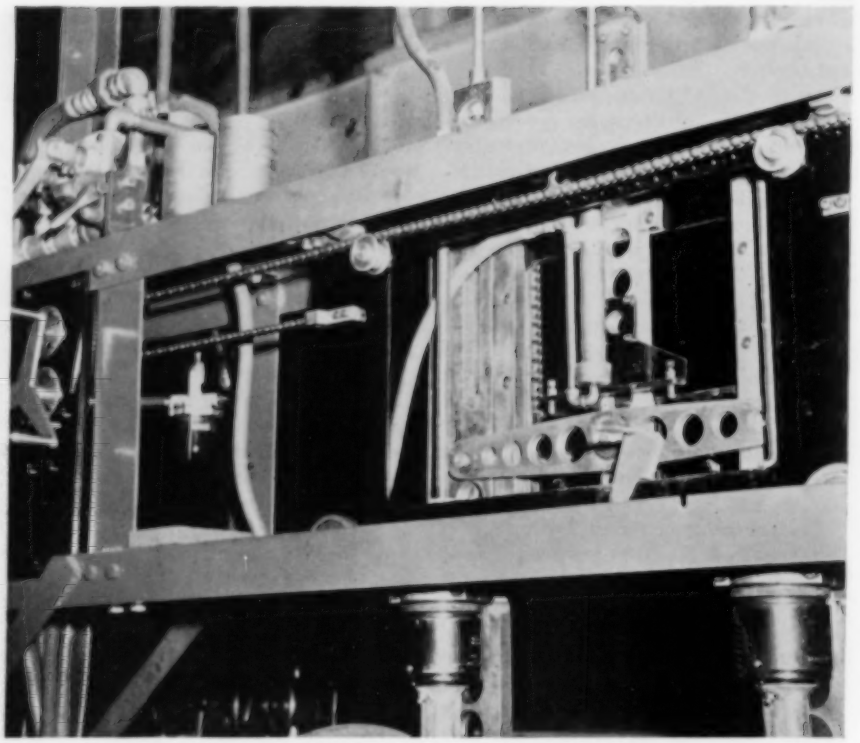
IRISH SEAWEED FACTORY

Western Ireland, like Scotland, is rich in offshore marine plants which are harvested in large quantities for the extraction of their chemical contents.

DETAILS OF MECHANISM

Slide-mounted air motors with the brushes they operate are illustrated below. The other picture shows the traveling carriage with the equalizing arm and air cylinder by means of which the brush slides are raised and lowered. An over-all view of the machine with a car axle in cleaning position appears on the cover.





Cleaning Car Axles Preparatory to Magnafluxing

*F. A. Corson**

THE requirements of the Association of American Railroads that all railway-car axles shall be magnafluxed has created the problem of discovering a safe and efficient method of thoroughly cleaning them preparatory to performing that operation. To the uninitiated, magnafluxing is a simplified method of detecting surface cracks, seams, etc., in steel that cannot be discovered by the aid of even a powerful microscope. The part to be inspected for flaws is magnetized and then sprayed or flooded with oil in which finely powdered black magnetic iron is held in suspension. Magnetization sets up a polarity between any cracks or breaks at or close to the surface of the metal and attracts the particles of iron oxide to them. There they adhere, forming a black line that is plainly visible.

In order that the work of cleaning might be done economically, the New York Central Railroad Experimental Department, which is located at the Collinwood Shops in Cleveland, Ohio, has recently designed and built an air-operated machine that is said to have several distinct advantages, namely: low first cost; high volume production at low labor cost; and minimum operating and maintenance expense. The equipment straddles the incoming tracks but does not interfere with the passage of wheels and axles that are not to be cleaned. And as the operation is completed before the wheels are demounted, no heavy lifting or transfer of wheels and axles is required.

Wheels and axles, as a unit, are simply run on a standard-gauge track through the machine. If the axle is to be cleaned, it is spotted over a pit housing an elevating and rotating mechanism by means of which the axle is turned on its own wheels. The wheels, themselves, are rotated at a speed of 25 rpm. by an Ingersoll-Rand Size 40 Multi-Vane close-quarter drill which is directly mounted on a shaft to which are keyed four heat-treated, serrated steel wheels 8 inches in diameter. The speed can be regulated by a needle valve placed ahead of the drill. The elevating mechanism is raised and lowered by two air cylinders installed in the pit.

Cleaning is done by two Osborne Manufacturing Company wire cup brushes each of which is powered by a Size 4 Multi-Vane air motor and operated at 4500 rpm. The motors are attached to two vertical slides which form part of a traversing carriage that runs in a 12x21x 114-inch box section and is moved by a hand wheel. The two bottom angle irons of the box section, which is fastened to two vertical end supports and spans the pit, serve as a track on which the ball-bearing wheeled carriage rides.

The vertical slides to which the air motors are secured are suspended on a balancing arm which is raised and lowered by a small pneumatic cylinder. This method of suspension permits equalization of the brushes, causing them to conform to the out-of-round and contoured ends of the axle. Pressure on the brushes is controlled by a counter-balancing weight on the back of the carriage.

Air is used at a pressure of 90 psi. and is filtered to remove vapor and foreign matter. It is delivered to an upright pipe, on one side of the frame, which carries it into the pit and to an overhead extension with three hose connections leading to the air motors and cylinder on the traveling carriage. There are three Norgren line oilers, one each for the brush motors and the Multi-Vane drill that turns the car wheels, while six Alemite grease fittings on the elevating mechanism do all the lubricating that has to be done daily.

By means of the machine one man, it is claimed, can thoroughly clean a railway-car axle in 2½ minutes. This speed and economy of operation is largely attributable to the use of standard compressed-air motors and pneumatic cylinders and to the fact that the work of cleaning is done without handling—lifting and lowering—the wheels and axles.

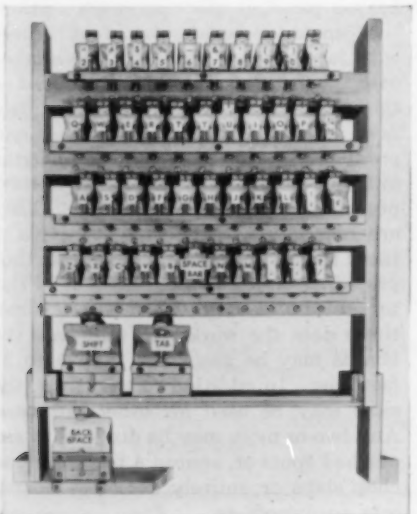
*Supervisor Experimental Department, New York Central Railroad.

An Air-Operated Automatic Typewriter

AUTO-TYPIST CONSOLE

Any standard typewriter can be converted to automatic operation by mounting it as shown here. The dials at each side are switches for making the change from manual to mechanical operation. Perforated record rolls, one containing various paragraphs and the other names and addresses, are mounted inside the housing. The operator selects the ones desired by punching numbered keys on each side of the machine. Paragraphs may be typed in any sequence, the roll turning at high speed until the one designated is reached. Then it slows to typing speed.

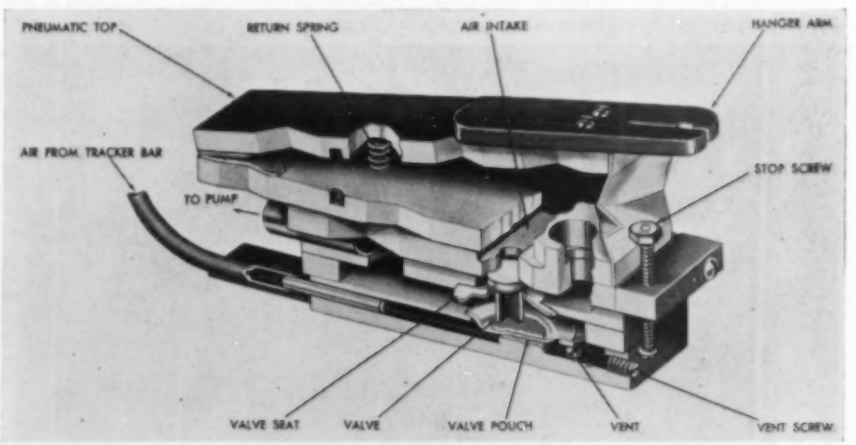
AIR is taking over one of the big time-consuming chores of stenographers and typists, that of writing form letters which differ only in address and salutation. Much of the typed material sent out by offices and agencies is direct-mail advertising and stock replies to routine inquiries. To facilitate clerical work of this kind, the American Automatic Typewriter Company has developed the "50" series air-operated Auto-typist, a machine that will automatically turn out up to 100 average-length paragraphs by means of any standard typewriter.



Perforated rolls, similar to the record rolls which operated the old player piano, are fed to the Auto-typist. Two are generally used and are punched on a special machine either in the office or by the manufacturer of the Auto-typist. One carries names and addresses taken from a mailing list; the other is perforated with a series of holes which represent the letter to be sent to each name on the list. But in the case of mail for which no address roll has been cut, the addresses as well as the date are typed in the regular way and only one roll is used to operate the machine automatically. Many different letters can be written simply by changing the record roll, a one-minute job.

Operation of the machine is based on the vacuum principle. Vacuum is induced by an electrically driven pump consisting of four bellows, each connected to the crankshaft spider by a pump strap. The bellows work in succession and the action is continuous, so that vacuum is maintained all the time the motor is running. A vital part of the mechanism is a tracker bar, a metal strip with a series of holes, one for each typewriter key as well as for the shift, tabulator, stop, skip, repeat, and rewind actions. Rubber tubes connect the tracker-bar openings with the various keys and with "action pneumatics" mounted in banks underneath the typewriter. There is one for each key, to which it is connected by a wire.

When the operator presses a push button to start the Auto-typist, the roll is drawn over the tracker bar. Outside air enters one of the pneumatics through a valve mechanism, equalizing the air pressure exerted on top of the pneumatic while a compression spring keeps the bellows in raised position, as shown in an



HOW KEYS ARE OPERATED

The bank of "action pneumatics" shown at the left is mounted under the typewriter. Each pneumatic—one for each character on the keyboard—is connected to its key by a wire. A cutaway view of an individual pneumatic appears above. The hanger arm is normally in the position shown, being kept raised by the return spring. When the roll perforation corresponding to the key is reached, a valve opens a channel leading to a bellowslike space beneath the hanger bar and the air is exhausted. The bellows then collapses, draws down the hanger arm and thus actuates the key. As the roll moves on, the connection to the vacuum pump is broken, air is admitted to the bellows, and this, plus the spring action, raises the bar and lets the key return to rest. The striking force of the keys is regulated by a governor that controls the degree of suction induced. Typing speed depends upon the rate at which the record rolls turn.

accompanying illustration. As each perforation in the roll passes over the corresponding hole in the bar, an impulse of air from the tracker bar travels down through the tube to the valve and enters the vent channel below the valve pouch. This combination of atmospheric pressure on the underside of the pouch and pump suction on the upper side causes the pouch to lift the valve off its seat and to close the air intake. When in this position, the valve opens a passage from the bellows to the vacuum channel, permitting the pump to withdraw the air from the bellows. The latter then collapses, drawing down with it the hanger arm and wire to which the typewriter key is attached, thus actuating it.

As soon as the opening in the tracker bar is closed by the movement of the roll, the flow of impulse air through the tube ceases, the vacuum pump withdraws what air remains in the tube and vent channel, and the valve pouch and valve return to their normal or "down" position. This closes the passage from the bellows to the vacuum channel and opens the air intake. The flow of outside air into the bellows, plus the action of the spring, raises the bellows and releases the typewriter key. The sequence of operations is almost instantaneous, and the key is released in time to make room so the next key can come into action.

Any make of typewriter, including noiseless, can be easily mounted on the Auto-typist. In the case of an electric machine, the carriage is returned by a key on the typewriter keyboard that is depressed by a small pneumatic like those that operate the other keys. On all other types it is shifted by a cord fastened to the spacer lever at the side left of the carriage proper. The speed at which the Auto-typist works varies with the typewriter and is set at the time of installation. The touch is adjustable so it will correspond to that of the operator.

Speeds may run as high as 150 words a minute, or sufficient to produce up to 200 letters a day. The machine also addresses envelopes automatically at the rate of nearly 1500 daily and can be used to do billing and invoicing with a typewriter designed for that purpose, the Auto-typist printing the address, terms, and services rendered. It is claimed that the machine, largely because of the flexibility of the pneumatics, permits operating any typewriter at its maximum speed and, what is also important, leaves the typist free for nonrepetitive work while it is in action.

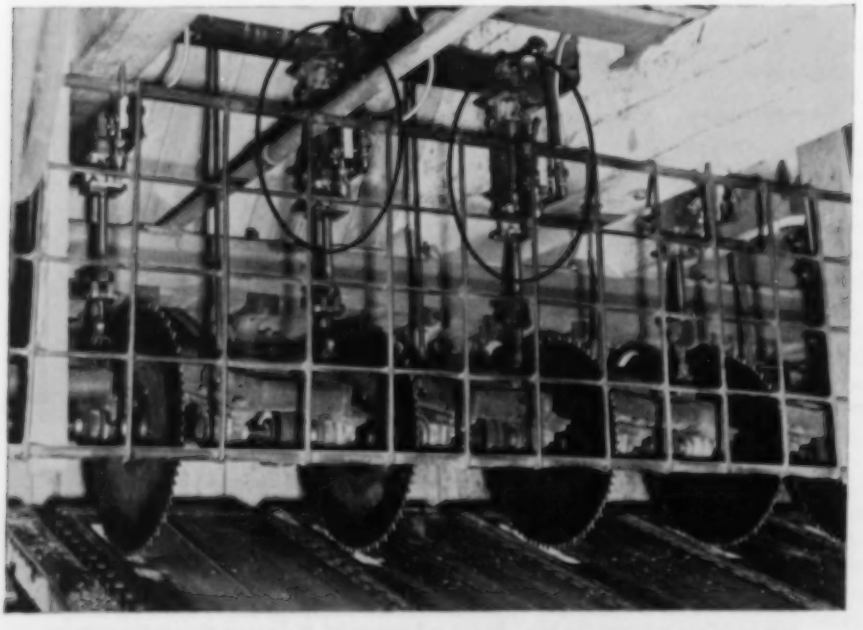
UNOBTRUSIVE STACKS

This municipal power-generating station in Lansing, Mich., has stacks but they are hardly evident. By designing them on the venturi principle, with induced-draft fans in their bases, Prat-Daniel Corporation, of East Port Chester, Conn., kept them so short that they could be concealed in the parapet at the top of the plant. At first glance the structure looks like an office building. This aesthetic touch was imparted to it in deference to the civic pride of the residents of Michigan's capital city.

Lumber Trimmer with Air-Controlled Saws

ONE of the newer of the many applications of compressed air in sawmills is that in connection with a "pony" trimmer built by Galbraith & Sulley, Ltd., for a Vancouver, B. C., plant. It is a small version of the heavy automatic type that is standard equipment in most West Coast lumber mills. But where the latter takes boards and timber up to 8 inches thick and 40 feet long and trims and cuts them into commercial lengths, the maximum capacity of the smaller unit is around 4 inches and 21 feet, respectively.

The installation in question has eleven circular saws arranged side by side with varying distances between them: Nos. 1 and 2 are 1 foot apart; Nos. 2 and 3, four feet; and Nos. 3 and 11, inclusive, 2 feet. Each is independently mounted above an inclined table in a hinged frame and is V-belt driven from a shaft passing through the hinges and direct-connected to a 40-hp. motor. The pneumatic feature of the trimmer is a group of 4-inch-diameter cushioned air cylinders, one to raise and lower each saw. They are of the heavy-duty Ledeen type and have a 6-inch stroke. Normally they hold the saws approximately 10 inches above the table. Drawing air at a pressure of 80 to 90 psi. from an overhead pipe, they are actuated independently or in any desired combination by Valvair 3-way solenoid valves remote controlled from a push-button panel at the operator's station.



IN CUTTING POSITION

Shown here are a few of the eleven circular saws on the "pony" trimmer. Each is connected to a vertical air cylinder (in black ovals) by which it can be raised and lowered at the rate of 40 times a minute.

Motor-driven chains on 2-foot centers with lugs every 3 feet carry the lumber over the inclined table to the trimmer at the rate of one every 1½ seconds, two saws meanwhile cutting off the ends and producing boards of even or odd lengths in 1-foot multiples, depending upon their position on the traveling chains. They are generally placed so that Saw No. 2 trims the end nearest the operator, thus providing pieces 4 to 20 feet long. But to prevent wastage, Saw No. 1 sometimes does the work. In that case the boards may be anywhere from 5 to 21 feet long. In addition to trimming, the saws may be used for other purposes. Any two or more may be dropped to cut out bad spots or, spaced 4 feet apart, to chop slabs or entirely defective boards into cordwood.

Determining Leakage Losses in Compressed-Air Systems

Lewis H. Carter

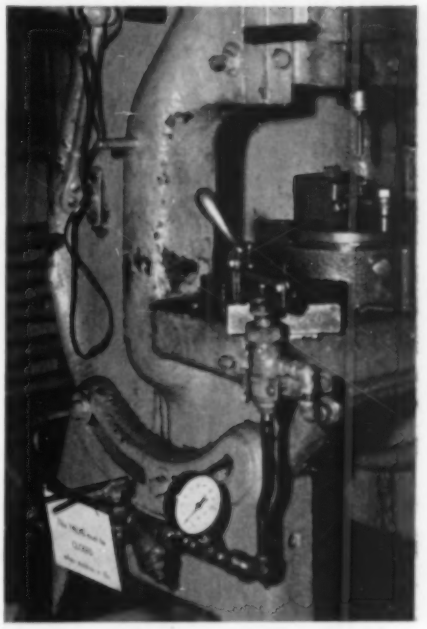
HOW much air are we losing because of leakage? What does it cost? These questions often bother the factory maintenance supervisor who is responsible for supplying compressed air through a network of lines to many "users." Careful as he may be in eliminating audible leaks, unless he has a method of accurately testing the system, he is never sure that he has detected them all.

By a simple method followed by the Worcester Pressed Steel Company it was possible to determine not only the amount of air lost at the points of application and in the piping system between the compressor and the machines but also its cost. The firm then knew how much it could afford to spend to eliminate the losses. The tests also revealed which of the users were the worst offenders and required immediate attention.

Before any check was made, each machine was equipped with a stop cock which, when closed, cut off the supply of air ahead of all outlets and control valves. Although each already had a shutoff, it could not be relied upon and was replaced in every case by a 125-pound steam cock. On the user's side of the latter was installed a strainer and a tee for the insertion of a test gauge when desired. The tests were conducted during the lunch period, when no air was consumed, and on two consecutive days. One was made with all stop cocks closed and the other with all stop cocks open.

The air was furnished by a 304-cfm. Ingersoll-Rand Type ES-1 compressor with a discharge pressure of 85 psi. For the purpose of the tests it was clocked by a stop watch, graduated in decimals of an hour, which was started from zero each time the unloading valve opened or closed. This gave the elapsed time it was idling and the elapsed time it was loaded, the sum of the two being the cycle time. The recorded time was the average of all the readings made during each test. Wattmeter readings were taken to ascertain the horsepower needed by the compressor when idling or when loaded. The cost of electric current per meter horsepower per year was set at $500.00.

To determine the leakage at each machine, a test gauge was inserted in the tee which was provided for that purpose. After closing the cock, the pressure drop within 30 seconds was noted. These readings were compared and showed which equipment needed immediate attention. In nearly every case the control valve was found to be defective. Since this resulted in a monetary loss of more than $500 a year, the economies effected by repairing or replacing the valves would cover their cost in a short time.



TEST EQUIPMENT

The air-supply line of a press fitted with a special stop cock followed by a pressure gauge.

The tests involved 146 users and, roughly, 1000 feet of piping between them and the compressor. At the time they were undertaken there were no audible leaks anywhere in the system, showing that it is possible to have a multitude that are not ordinarily detectable and that can run into an appreciable loss in dollars and cents.

The accuracy of the tests depended upon a perfectly airtight shutoff at each machine. Because the cost of a reliable cock, plus that of installation, is fairly high, it was necessary to decide whether or not the savings justified the outlay. The facts which governed the matter were these: Roughly, 90 percent of the users were presses, and each had two manually operated valves which controlled the action of the clutch. Many had rubber-hose take-offs to auxiliary apparatus. This added up to some 350 possible leakage points. Eliminating the leaks at all of them would take a considerable length of time, and it was preferable to spread the cost of material and labor over a period of months.

With the cocks as installed, it is possible to locate the worst offenders by means of the gauge test and to make immediate savings by requiring operators to keep the cocks closed on idle equipment. Instead of providing one plug cock for each user, a compromise can be made

TEST NO. 1, ALL STOP COCKS CLOSED

Loaded time	0.0063 hr.
Idling time	0.0654 hr.
Cycle time	0.0717 hr.
Ratio loaded time to cycle time	0.0880
Ratio idling time to cycle time	0.9120
Cycle time	1.0000
Electrical horsepower used	
Compressor loaded	70 hp. x 0.088 = 6.26 hp.
Compressor idling	15 hp. x 0.912 = 13.65 hp.
Average horsepower	19.91

If all leaks had been eliminated, the compressor would have been idling 100 percent of the time and would have used 15 hp. The excess over and above 15 hp. was needed to compensate for leaks between the compressor and the stop cocks. It amounted to 4.91 hp. and involved an expenditure of $245.50 a year.

TEST NO. 2, ALL STOP COCKS OPEN

Loaded time	0.0089 hr.
Idling time	0.0189 hr.
Cycle time	0.0278 hr.
Ratio loaded time to cycle time	0.3300
Ratio idling time to cycle time	0.6700
Cycle time	1.0000
Electrical horsepower used	
Compressor loaded	70 hp. x 0.330 = 23.10 hp.
Compressor idling	15 hp. x 0.670 = 7.08 hp.
Average horsepower	30.18

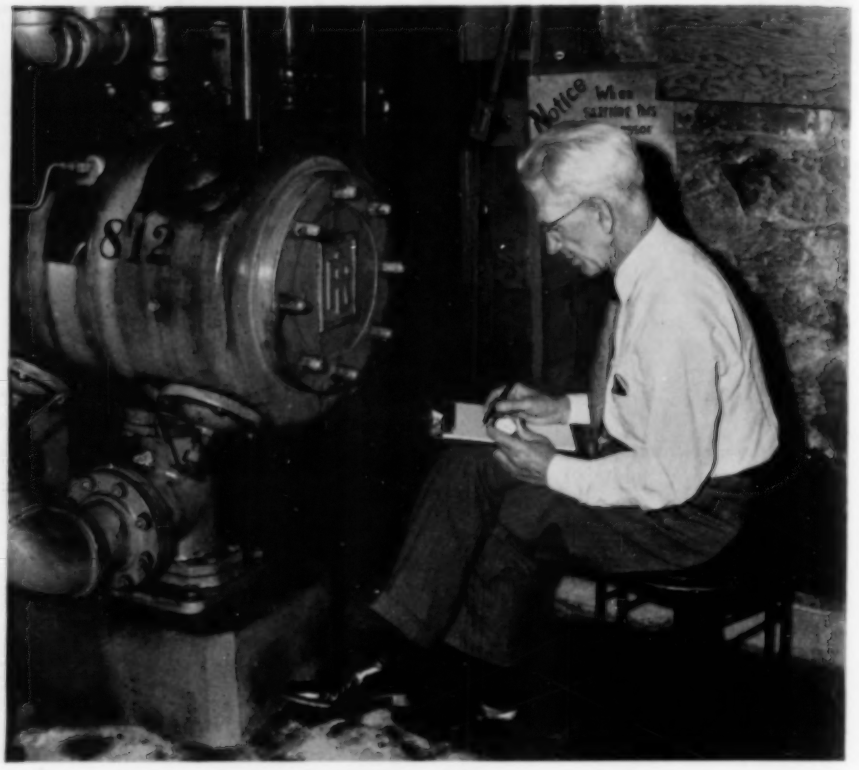
In this case the excess power required to make up for leakage in the whole system totaled 15.18 hp. and cost $759 per year.

ANNUAL COST OF LEAKAGE

Total amount, whole system	$759.00
Pipe lines	245.50
In equipment at user	$513.50

by grouping several machines and controlling them by a single shutoff. If it is desired to ascertain the cost of the compressed air for the purpose of allocating it to the respective users, and if no flow meter for measuring the amount generated is available, fairly accurate results may be obtained by the tests outlined.

To arrive at an average more nearly representative of working conditions, it is necessary to know the ratio of loaded time to idle time over a longer period than that on which the tests were based. By rigging up a device for closing an electrical circuit during the interval the compressor is loaded, and by putting an electric clock in the circuit, the loaded time will be integrated. Comparing this integrated loaded time with the total time the compressor is in operation will give ratios as worked out in the tests. Assuming that this time was found to be thirteen hours in a 40-hour week, the total volume of air produced in a year by a compressor of the type used would be: 304 cfm. x 60 x 13 x 52 = 12,330,240 cubic feet. At $50 per horsepower per year, the cost for electric current (70 hp. x 13/40 + 15 hp. x 27/40) would be $1,644.75. To this should be added the outlay for cooling water and the proportional cost of the fixed expenses of the station.



TIMING OPERATION OF COMPRESSOR

The author is shown taking stop-watch readings at the compressor to determine operating and idling time during each cycle.

This and That

Marking Michigan Highways

Painting traffic guide lines on the nation's highways is a big job. In Michigan, for instance, it costs $250,000 a year, and it takes from three to four months to remark some 7500 miles of hard-surfaced trunkline roads. This year, seven crews, with as many striping machines, started the task in the southern counties in May and are steadily working their way northward.

Because the average driver will not refrain for more than a limited time from crossing and smearing freshly painted lines, much study goes into developing quick-drying paints and applying them under varying weather conditions and at different times of day to determine the effects. Michigan highway engineers specify a paint that will dry to the smear-proof stage within ten to twenty minutes. At the usual striping speed, this means that there are about 2 miles of wet paint behind a machine, and "no-crossing" flags are stationed that entire distance.

Michigan's 1950 program will require 79,500 gallons of paint. Of this, 24,750 gallons will be yellow for marking center lines of 4-lane undivided highways and no-crossing lines on hills and curves of 2- and 3-lane stretches. Another 39,750 gallons will be white to mark blacktop roads and some concrete surfaces. Finally, 15,000 gallons of black paint will be applied to certain concrete highways where that color seems to be the most effective. All yellow and white paint is rendered luminous at night by adding millions of tiny glass reflectorizing beads. About 6 pounds are used for each gallon of paint.

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Unusual Cooling Application

Disposal of slag from blast furnaces located in urban areas presents some problems because there is little room where it can accumulate. These conditions prevail at the Pittsburgh Works of Jones & Laughlin Steel Corporation. There the molten material remains in pits only long enough for it to solidify and is then removed by the Duquesne Slag Products Company and processed for use in building blocks, as a road-surfacing material, etc. Loading into cars is done with a power shovel, and the operator's lot was formerly an undesirable one. The temperature of the air mounted as high as 160°F., and fumes, dust, and steam rose from the slag. Two large propeller-type fans were mounted on the front of the shovel in an effort to improve conditions, but their effectiveness depended largely upon the direction and velocity of the wind.

Now the operator works in relative comfort, thanks to equipment that cools the cab. Mounted on the top of it is a Dravo air-conditioning unit of the ammonia compression type. It delivers 400 cfm. of air to the cab and also cools and ventilates the machinery compartment of the electric shovel. Three-quarters of the cab air is recirculated. The remainder, which is taken from the outside, is filtered and passed through canisters containing activated carbon to remove fumes and gases.

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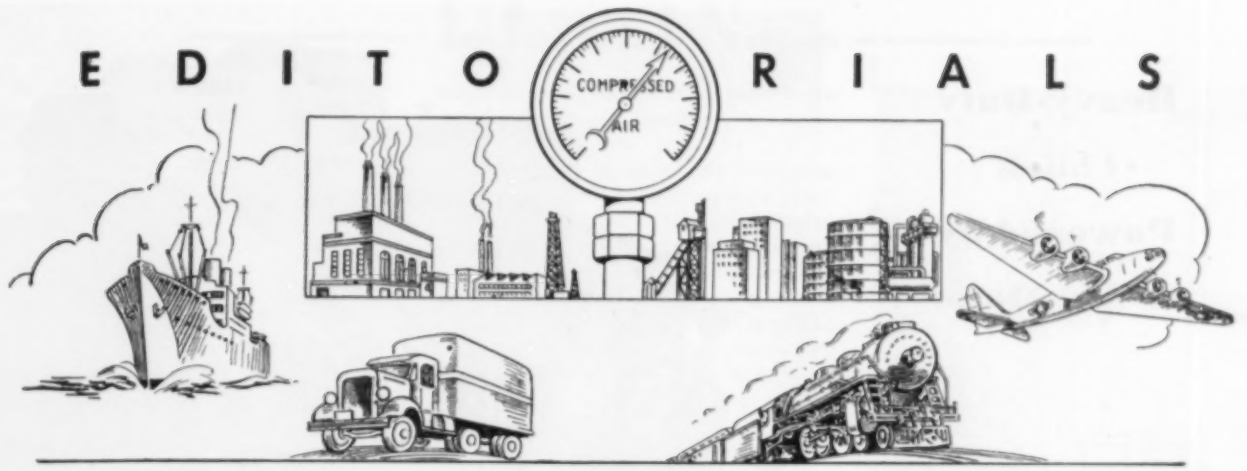
New Metal Facts

Although textbooks have always stated that metals melt and solidify at identical temperatures, it isn't true according to metallurgists of the General Electric Research Laboratory. Examination under special microscopes of droplets of molten metals that are entirely free of impurities reveals that they solidify at much lower temperatures than they melt. When impurities are added, the melting and solidification points coincide, as the textbooks state. Selenium, bismuth, lead, antimony, cobalt, iron, and palladium have so far been studied, and in all cases the temperatures at which the pure droplets solidified were roughly 20 percent below the melting points of the metals in terms of degrees above absolute zero.

EDITORIALS



SILTING OF RESERVOIRS

THE often expressed fears that reservoirs on some of our western rivers will become filled with silt in a comparatively short time have been determined to be groundless by the Bureau of Reclamation. The latter has contended right along that this was so, but up to now has had little more than theoretical calculations to back up its stand. During the past two years, however, the U. S. Geological Survey and the Navy Department have measured the actual rate of siltation in several reservoirs, including Lake Mead, which was created by Hoover Dam and is the world's largest man-made body of water.

Reporting on these investigations, Oscar L. Chapman, Secretary of the Interior, states that it will require at least 275 years for Lake Mead to become completely filled with material borne by the Colorado River even if no upstream dams are built meanwhile. Actually, several of the latter are in the drawing-board stage. Studies reveal that Lake Mead has trapped an average of 105,500 acre-feet of silt each year since water storage began in 1935. This is just 500 acre-feet more than was predicted by Bureau engineers before Hoover Dam was reared.

At this rate, the basin will not be entirely filled with silt until the year 2225. Actually, the engineers say, the silt will not build up at the prevailing rate because lower deposits will be greatly consolidated as additional tons of material are superimposed upon them. Taking this into account, they compute that the reservoir will have some useful storage space until the year 2380.

Methods developed by the Navy to locate submarines and sunken ships and to chart the ocean floor have been used in the reservoir investigations. They show that coarse gravel and sand settle soon after they reach the backwater of the lake, while the more finely divided material is carried farther into the body of the reservoir. The old river channel of the Colorado is now filled, but there has been little sedimentation outside its boundaries except at the head of the lake. The storage capacity of the reservoir is computed at 29,827,000 acre-feet, as compared with its initial capacity of 31,142,000 acre-feet.

Similar investigations in the reservoir behind Elephant Butte Dam on the Rio Grande River, which is known as a bad silting stream, disclose that it has lost 16½ percent of its capacity in 32 years, indicating that it still has 160 years of service ahead of it. The Arrowrock Reservoir on the Boise River in Idaho has lost only 2.76 percent of its capacity in 32 years, and at that rate of siltation is good for 1100 more years.

The Guernsey Reservoir on the North Platte River in Wyoming has the highest rate of siltation of any U. S. Reclamation storage facility so far studied. In twenty years 33 percent of its capacity has been taken over by silt. But even at this rate its useful life will extend well beyond the 40-year payout period.

Commenting on the results of the investigations, Secretary Chapman said: "Some misinformed people say it is wasteful to build big dams such as Hoover because they will soon be ruined by silt. That is just simply not true." He urged, however, that vigorous conservation measures be taken to prevent excessive erosion and to keep the silt on the land where it belongs.

TRAINING EXECUTIVES

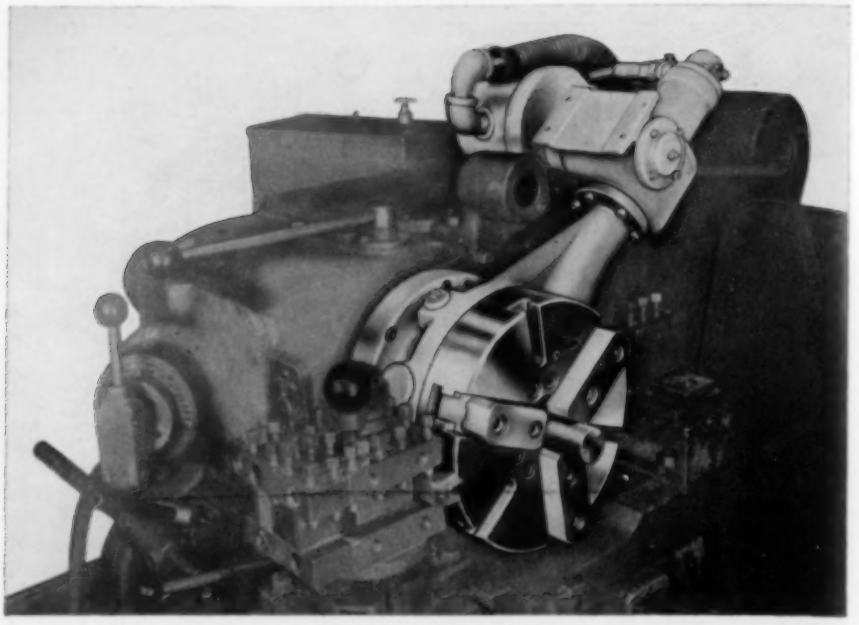
IN THIS age of specialists, men who know how to do one thing well constitute a major part of our working force. The day of the jack-of-all-trades has passed. The American system of manufacturing is based on dividing big operations into a multitude of little ones. Each worker thus learns his particular job thoroughly. Then, if everyone does his allotted part, the production machine clicks. That is, it does if it is properly directed. Without competent management to gear each operation smoothly with the others, chaos can result. Even a baseball team composed of experts at every post will not win consistently unless someone does its master-minding

In the industrial world, this emphasis on specialization is creating a dearth of executives, according to Ralph J. Cordiner, executive vice-president of General Electric Company. Too few men get a chance to learn how all the positions should be played, and without that knowledge they can't lead the team to victory. Industrial executives who have been at the helm for many years are compared by Mr. Cordiner to a family doctor. The present-day manager knows his business, he states, because he has been with it "through its labor pains, its growing pains, and, in place of measles and mumps, two world wars and a depression. His successor, however, must come from the ranks of specialists whose specialties have narrowed their outlook and who have not had natural opportunities to exercise leadership.

"Companies have for a long time done a good job of recruiting and early training, but too often, at the most critical period in the development of an executive, we have neglected to provide any opportunity for training at all. We suddenly find ourselves doing one of two things: We take the man who has been specializing during some of the most important formative years of his life and give him a title, saying, 'Now, you're a manager.' Or we find ourselves saying, 'We'd like to promote a man from within the ranks, but none of them has the proper qualifications.' "

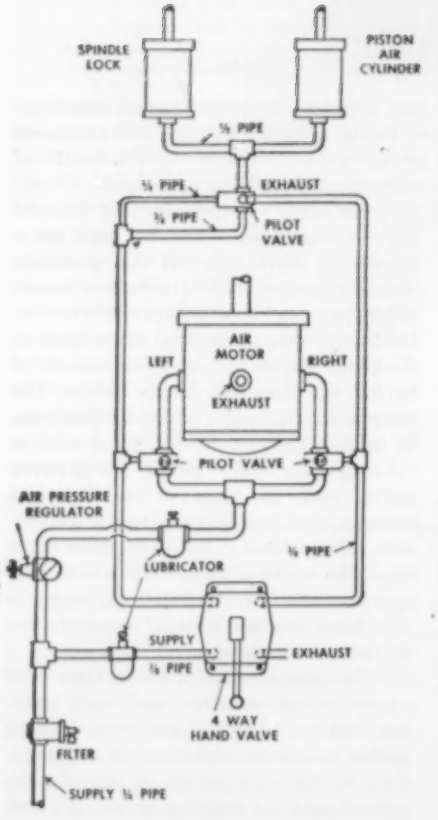
Mr. Cordiner suggests two courses as a remedy for the situation. First, he would rotate selected specialists on jobs of different kinds to give them a well-rounded training. Second, he would provide all executives with understudies or assistants who would concern themselves with the over-all managerial aspects of an organization's operations. These men should, he states, have a chance to learn how to select people and coördinate their efforts by defining responsibility, authority, and accountability. Also, they should come to understand human relations, and develop sensitivity for social, economic, and political trends.

Heavy-Duty Chuck Powered by an Air Motor



INSTALLATION VIEW

The chuck mounted in working position with the air motor mounted towards the rear of the machine. This arrangement leaves a clear center hole for the insertion of the work, which ranges from bar stock to round and irregular pieces. The drawing shows the layout of the control system.



A NEW type of automatic chuck called Air-O-Torque has been developed by The Whiton Machine Company and is said to combine the best features of a pneumatic chuck and a chuck operated by a power wrench. It is made up of two components: a heavy-duty gear scroll chuck and a power unit. The latter consists of an air motor, worm gear, worm shaft, and a retractable splined pinion shaft and is built into the chuck housing, which is attached directly to the machine headstock.

Control of the chuck is effected by a 4-way, hand-operated valve. Power produced by the air motor is transmitted through the worm gearing and shafts to the scroll, causing the jaws to open or close. Air pressure used to operate the motor can be varied from 0 to 90 psi. by a regulator, thus altering the amount of torque developed by the unit and insuring a positive grip on the work. The jaws can be moved a fraction of an inch or any distance within their limits.

The center-hole chuck can take bar stock, round or irregularly shaped work, thin-walled pieces, etc., with equal facility, and as the scroll can be engaged at any time anywhere on the chuck periphery by the retractable pinion shaft it is not necessary to locate the pinion opening manually when inserting work.

The body of the chuck is an alloy-steel forging, and a special heat-treated alloy steel is used for the heavy-duty jaws and the scroll, which is chrome-plated for long wear and accuracy of operation. The Air-O-Torque is suitable for use with lathes, boring mills, automatic chucking machines, etc., and can be fitted to any American Standard spindle or designed for a special spindle or plate. It comes in seven sizes from 8 to 24 inches chuck diameter. Larger units are obtainable.

Leak Detector for Pneumatic Control Systems

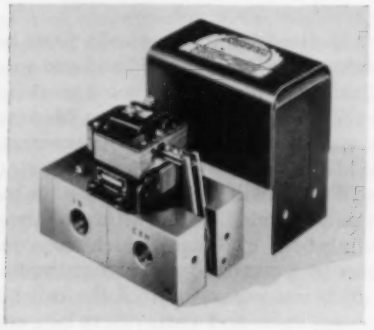
BRITAIN is known to prefer pneumatic to hydraulic control systems for aircraft, and that explains the development there of a device for the detection and location of leaks in compressed-air lines on planes. The instrument consists of a control unit and a hand-held detector with a long nozzle to probe the atmosphere for the presence of a "tracer gas"—a halogen compound that is injected into the air system in liquid form. It is nontoxic, and is easily introduced from small cylinders containing 1 to 2 ounces, giving a concentration at full testing pressure of about 1 percent.

The detector has a motor-driven impeller, an element sensitive to vapors of halogen compounds, and a small loudspeaker which normally emits a clicking sound. When in use, the impeller draws ambient air through the element, and when the latter detects in it the presence of the tracer gas the frequency of the clicking sound is amplified, giving an audible signal. The meter reading on the control unit increases at the same time, visually indicating a leak in the compressed-air line at the test point. It is claimed that air with a halogen-vapor concentration of 1 percent or less escaping from a line at the rate of ½ cubic centimeter per minute is readily detected. In terms of a pneumatic system having a total capacity of 300-400 cubic inches and operating at 1000 psi., this corresponds to a fall in air pressure of 2 psi. in 24 hours.

The required amount of tracer gas is injected into the pneumatic system when it is under reduced pressure so that it will be carried into the main receivers when the lines are under full pressure. In service, it is the practice first to test main zones such as cockpits, nacelles, etc., for possible leaks and, if found, to seal them before searching for lesser ones in the same area by placing the nozzle right against the pipe-line joints. Where these are somewhat inaccessible, a telescopic probe can be used. And in zones where background noises are excessive, the operator wears headphones so that he will be sure to hear the clicking sound that indicates a leak.

Industrial Notes

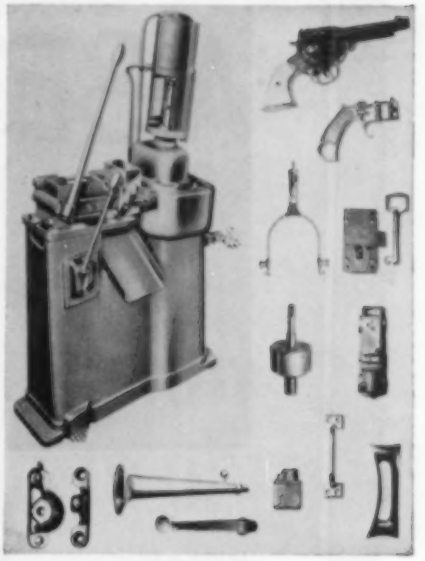
Model SL is the designation of a new Nopak ring-type solenoid valve announced by Galland-Henning Manufacturing Company. The unit is small and lightweight and has a 3-piece body machined from drawn aluminum that can be easily dismantled. It is energized by a continuous-duty, standard solenoid



that actuates a pilot and that is said to function efficiently even when submerged in oil. Neoprene "O" rings are used for sealing. At 220 volts, with a consumption of 0.96 ampere, it develops a pull of approximately 3 pounds and is operated with air at 40 to 250 psi. At present it is available only in the ½-inch pipe size which can be bushed down to ⅜- or ¼-inch size. The SL is designed for long-run, high-speed service or for continuous energization in one position.

In addition to supplying wrapping paper that is intended to protect products against corrosion, Nox-Rust Chemical Corporation is now equipped to make cartons of a similarly treated material to order. The chemical with which it is impregnated vaporizes and is said to offset the harmful effects of moisture that may be trapped in a package when it is sealed.

Die Casting Machine Corporation has announced a zinc-alloy die caster of 1-pound capacity that is said to combine fast chill and high cycling speed. Using single-impression dies up to 6x9 inches in size, direct valving "explodes" air under pressure into a charging cylinder, causing the piston to shoot hot molten metal into the die cavities before it has a chance to cool off and resulting in a small water-cooled sprue that solidifies instantly. Fabricated die blanks into which cavities can be machined are supplied with the machine. According to the manufacturer, the new model can maintain an average output of 500-700 shots an hour and eliminates most secondary operations and finishing costs. It occupies only 24x12 inches of floor space, making it especially suitable for small-parts producers who depend upon outside sources for their castings.



Pipe joints made with a new compound put up in cans by Hercules Chemical Company are claimed to be not only leakproof but easily broken. Product can be applied directly from container without mixing and is especially suitable for screw joints on water, steam, gas, compressed air, and ammonia lines, as well as for pipes carrying dilute acids and alkalies. Can be used without lampwick on brass piping.

Stone-Dri is the trade name of a waterproof enamel for the protection of masonry such as cement, stucco, and concrete. A product of Sapolin Paints, Inc., it is compounded to withstand the destructive chemical action of the lime and alkali in those materials, as well as to resist heavy traffic. It is said to retain the elasticity and toughness of its plastic-rubber base, which causes it to flow freely even on rough surfaces. The enamel is available in silver, lead gray, red, and green.

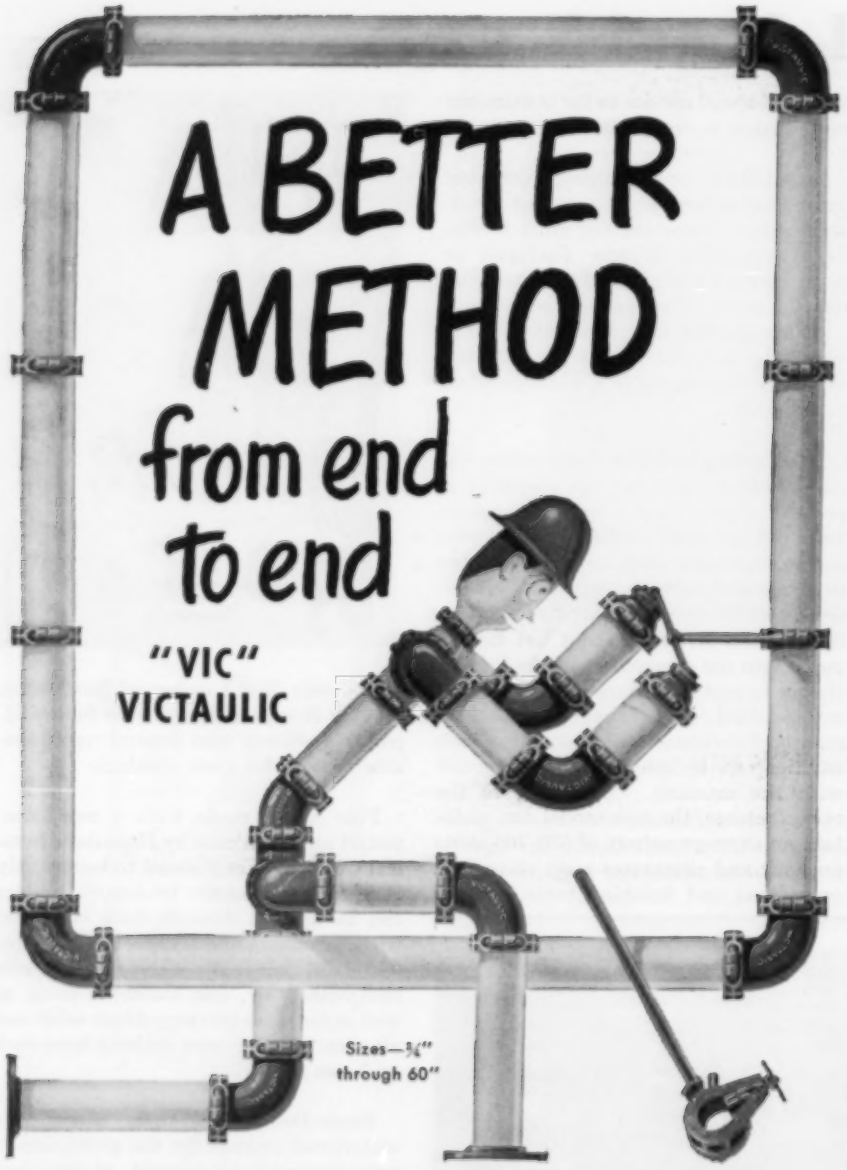
Metals exposed to temperatures ranging from 500 to 1200°F. are made heat resistant, it is claimed, by an aluminum paint called Tecosteel offered by Thompson & Company. It is applied by dipping, brushing, or spraying and air dries in twelve to eighteen hours. Can be baked dry at 350° in fifteen minutes. Recommended for coating annealing boxes, furnaces, hot air ducts, smokestacks, and superheated steam lines.

Reinforced tubing that is said to be highly resistant to rupture and collapse is offered in a wide range of diameters by

INTERNATIONAL NEWS PHOTO

NATION'S LONGEST VEHICULAR TUNNEL OPENED

Aerial view showing the route of the 9117-foot-long Brooklyn-Battery twin bores that link New York's Manhattan (in background) and Brooklyn boroughs. It was dedicated and opened to traffic on May 25 after being under construction intermittently since 1940. Each of the two tubes can handle 2800 vehicles an hour, with an average driving time from end to end of 3½ minutes. Tolls to repay the Triborough Bridge and Tunnel Authority for the $80,000,000 expended range from 35 cents for cars to $1.25 for trucks. A description of the construction of the tunnel was published in our September and October, 1947, issues.



No matter how you look at it, VICTAULIC offers a method of piping that will save time, work, and dollars on construction and maintenance from one end of the line to the other.

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* * *

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26TH VICTAULIC YEAR

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The easiest way to make ends meet
VICTAULIC
PIPE COUPLINGS AND FITTINGS

Flexible Tubing Company. Standard construction has a rustproof spring-steel helical core covered inside and out with cotton duck coated with Neoprene. Special types with multiple-ply walls and varied coatings are made to meet different service needs. According to the manufacturer, tubing is easily assembled and retractable. Named Spiratube, it is suitable for conveying gases under high pressure or vacuum, as well as light solids in powder or granular form.

A device that automatically feeds bar stock to turret lathes and hand and automatic screw machines is being marketed by OK Specialty Company, Inc. Mounted on tripod standards, it has a pneumatic feed tube that positions and aligns stock and feeds any desired length into the machine-tool spindle. A feature of the equipment is a plunger which stops just short of the collet jaws so that the final stub is not pushed out of the collet to damage tools, and waste due to long ends is eliminated. The plunger is withdrawn

by actuating an air-control valve, and a special safety device shuts off the air supply when the feed tube is in the reloading position. The device is operated with low-pressure air and will handle steel, brass, and aluminum rods, thin-walled tubing, and plastic stock in lengths up to 12 feet, in diameters limited only by the capacity of the spindle, and in round, square, hexagonal, rectangular, and other shapes. According to the company, the device, which feeds without surface contact, does not scratch or mar material, thus permitting the use of polished stock.

At the recent Philadelphia, Pa., tool show, Modernair Corporation exhibited what it describes as the first double-acting Air Return pneumatic cylinder. After the initial charge, it uses the same volume of air that a spring-return cylinder consumes, or half the amount required by a conventional double-acting cylinder. It may be operated by a 3-way valve and still permit throttling to provide for control of the work and of the return stroke. According to the Company, there is no residual pressure on the forward stroke, and the return stroke is

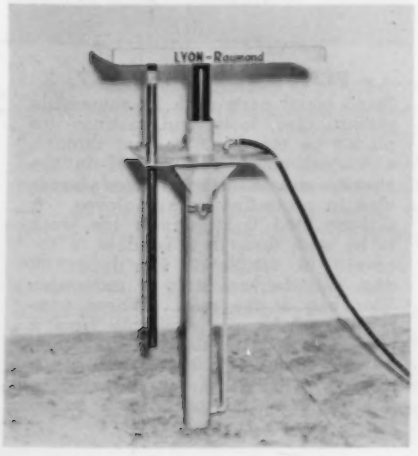
made at 60 percent efficiency by use of the 3-way valve. Built of brass, stainless steel, and aluminum, the Air Return is light in weight, and elimination of the spring-return element permits a reduction in over-all dimensions. The only replacement necessary is O-ring packing because there are no moving parts to wear, no metal to metal contact. The cylinder will soon be available in 1⅛-, 1¾-, and 2½-inch bore sizes.

Concrete blocks with an integral brick facing is a new building material introduced by National Bric-Block, Inc. It is made in all standard sizes in any color or combination of colors and with a plain or rough surface.

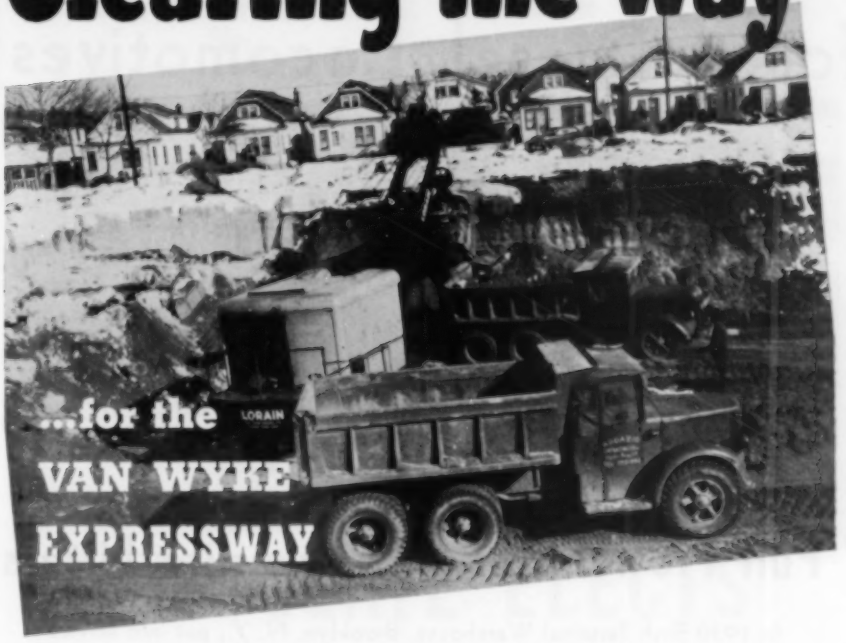
A 2-inch drain cock designed by Master Equipment Corporation for compressed-air systems is said to eject water and oil twice each time units taking air from the lines function. The device weighs only 3½ ounces and operates on the principle of pressure build-up and relief. It can also be adapted for use with automotive air-brake systems.

For field or shop use there is now available in a grained-cowhide case a pocket microscope that is said to be the equal of laboratory instruments in quality. It is free from prismatic aberrations and has an adjustable magnification range from 20 to 60 power. Made by Clarkston Corporation, it is designated as Model 233.

Engineers of the Lyon-Raymond Corporation have designed a simple form of elevating platform for light loads that is supplied as a packaged unit ready for installation below floor level. It is of the



Clearing the way



● Earth must move—before traffic can. So they're digging with Diesels—Waukesha Super-Duty Diesels! And at the rate the shovel is digging against this 16½-ft. embankment, that new New York State highway—the Van Wyke Expressway—will be completed in 1950 right on schedule.

The place is Long Island. The E. J. Varrone Construction Co., South Ozone Park, Long Island, N. Y., own the shovel. It's a 2-yd. 820 Lorain shovel—powered by the Waukesha Super-Duty Diesel Six.

It's a potent power producer—this heavy-duty, four-stroke cycle, overhead valve Diesel engine. With the exclusive patented combustion chamber used in all Waukesha Diesels you get unusual Diesel performance . . . clean burning with all standard "high speed Diesel fuels" . . . lively acceleration . . . high economy . . . easy starting . . . simpler maintenance. Send for Bulletin 1415.

WAUKESHA MOTOR COMPANY, WAUKESHA, WIS.
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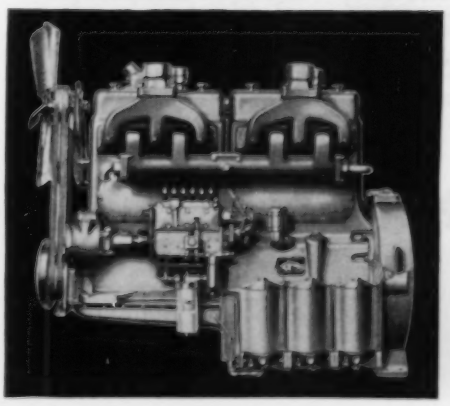
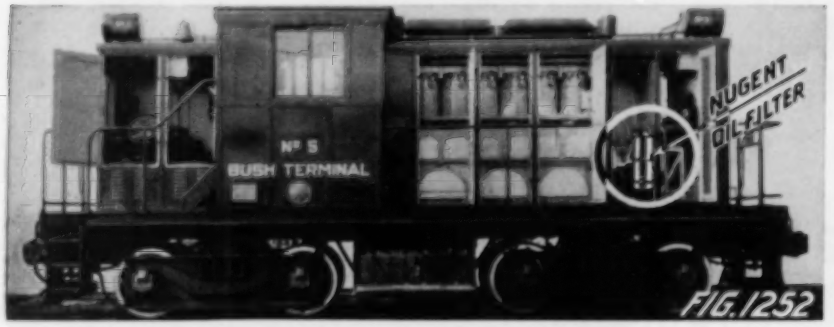


Diesel
ENGINES

WAUKESHA Super-Duty Diesel (Model 6-WAKD)—six cylinder, 6¼-in. bore x 6½-in. stroke, 1197 cu. in. displ.

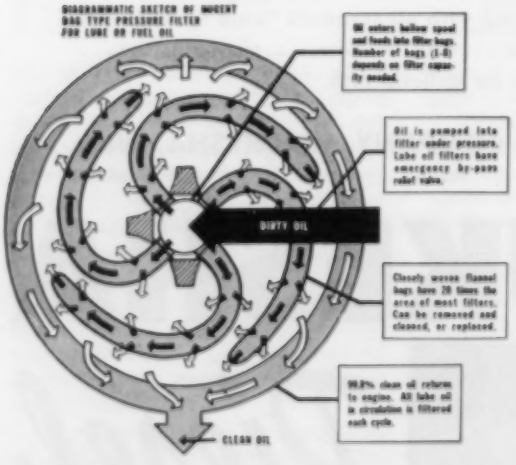
19 Years of Protection for 7 Diesel Locomotives



with NUGENT
"Full Flow Filtering" Pressure Filters

In 1930 Bush Terminal Warehouse, Brooklyn, N. Y., put into service seven Ingersoll-Rand diesel powered G. E. locomotives. All were equipped with Nugent "Full Flow Filtering" Bag-Type Filters for lube oil. Now after 19 years all seven locomotives are still in service and only one has had to be overhauled (that after 18 years service). The Nugent Filters are cleaned every three or four months and the bags washed and re-used. Here is proof of the long term economy and effectiveness of Nugent Full Flow Filtering.

Nugent "Full Flow Filtering" Filters are equally effective on compressors, pumps, turbines, gas engines, machinery etc. and may be used on a wide variety of oils and other fluids. What is your problem?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Oil enters hollow spool and feeds into filter bags. Number of bags (1-8) depends on filter capacity needed.
Oil is pumped into filter under pressure. Lube oil filters have emergency by-pass relief valve.
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Closely woven flannel bags have 20 times the area of most filters. Can be removed and cleaned, or replaced.
98.8% clean oil returns to engine. All lube oil in circulation is filtered each cycle.
CLEAN OIL

What is "Full Flow Filtering?"

"Full flow filtering is complete filtering of all the oil every cycle. No unfiltered oil by-passes the filter carrying harmful foreign material to moving parts. In Nugent "Full Flow Filtering" Filters, dirt is collected on the inside of the filter bags which when clogged can be cleaned and reused or discarded and replaced at your preference. For Maximum economy and longest equipment life be sure and specify Nugent "Full Flow Filtering" Filters.

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piston type operated with air at 90 to 100 psi. pressure by a hand- or foot-controlled valve and has a maximum capacity of 300 pounds. The top measures 30x30 inches and is designed to turn 360 degrees or lock in various fixed positions. The one shown is provided with a stop to prevent it from turning and has a total lift of 36 inches from a point 6 inches above the floor.

Another hardening compound for tool steel has been made available, this time by Doughty Laboratories, Inc. According to the company, the material is rich in chromium which, when fused with the metal, adds ingredients that have both an alloying and a nitriding effect. The result is a hard surface that is exceptionally impregnable and resistant to wear, corrosion, and high temperatures, while the core remains tough and flexible. The process is said to increase the life of a tool-steel drill, for example, as much as 300 percent.

Q 200 is the designation of a new fluid put on the market by Barco Chemical Products Company for degreasing metals and alloys preparatory to painting, lacquering, anodizing, metallizing, and electroplating. It is applied cold, thus preventing distortion through expansion and contraction when parts are cleaned with hot solutions or vapors. The chemi-

BENCH BLAST CABINET

Small metal parts such as automobile pistons, dies, tools, and castings are placed in this blast cabinet through a hinged cover and rotated in the abrasive stream by the operator's hands clad in protective rubber gloves. A side-mounted light permits the work to be seen through a window in the cover. A ventilating fan draws off dust and delivers it to a removable filter bag at the rear. Where compressed air is not available from a plant line it is furnished by a 5-hp., 2-stage compressor. The cabinet is made by The W. W. Sly Manufacturing Company and occupies a bench space of 14 x 18 inches.

cal is said to remove all traces of wax, oil, grease, moisture, and grimy finger prints. It also dissolves pitch and resins by which lenses are held in place during grinding.

By law, enacted last February, Alcoholina—a mixture of alcohol and gasoline—is now the national fuel for motor vehicles in the Republic of Panama.

Putty in windows can be softened for removal by a portable electric tool that has a grip handle and can be plugged into any 110-volt outlet.

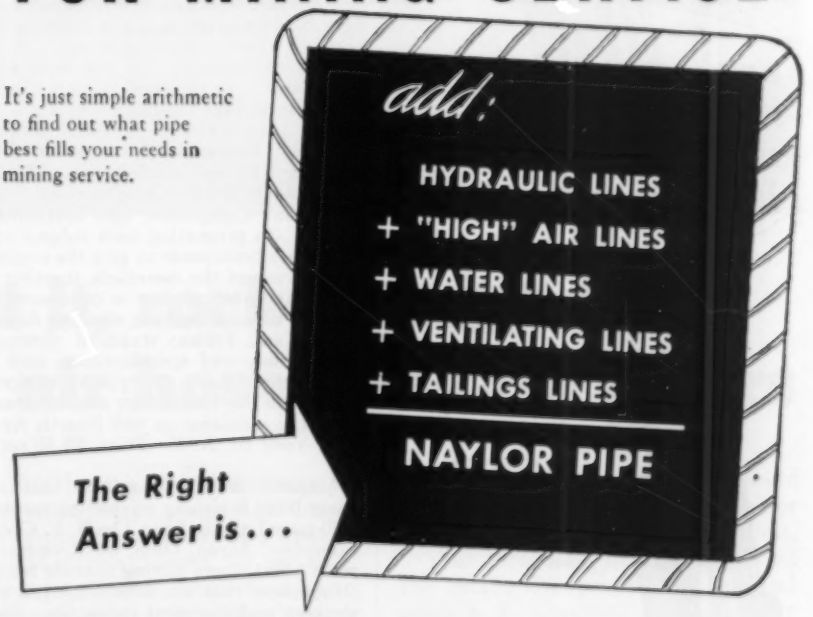
A new nozzle and a 4-finger trigger are features of a spray gun, Model GAT-2, recently announced by Eclipse Air Brush Company. The patented "47" nozzle makes it possible, it is claimed, to vary the spray pattern anywhere from the size of a silver dollar to a swath more than 12 inches wide, as well as to control it with accuracy. Adjustment is effected

by a thumbscrew on the gun and does not interfere with spraying. The trigger enables the operator to work for extended periods without finger fatigue and permits him to wear bulky gloves. The GAT-2 is served by separate lines for compressed air and coating material and can project a stream in a pattern up to 6 feet beyond the operator's reach. It is recommended for high-speed production painting in such fields as railroad, marine, building construction, and plant maintenance.

A new-model air purifier to which from one to six hoses can be attached has been announced by E.D. Bullard Company. Light enough to be classed as portable, it has a capacity of 10 to 35 cfm. of free air with a maximum working pressure of 100 psi. preset and controlled by a safety valve placed ahead of the manifold receiver. Combined chemical and mechanical filtering is provided by a replaceable cartridge. Standard ¼-inch tap threads permit connecting hose fittings to operate spray guns and tools, as well as air lines of protective breathing hoods or helmets.

THIS SLATE ELECTS NAYLOR PIPE FOR MINING SERVICE

It's just simple arithmetic to find out what pipe best fills your needs in mining service.



The proving factor is Naylor's exclusive Lockseam Spiralweld structure which makes Naylor Pipe stronger, safer . . . superior to ordinary lightweight pipe in mining service. Sizes from 4" to 30" in diameter with all types of fittings, connections and fabrications.

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New Books and Industrial Literature

A handbook of helps for industry in controlling air pollution has been published by the Industrial Hygiene Foundation of the Mellon Institute, 4400 Fifth Avenue, Pittsburgh, Pa. The effects of contaminated air on the health of persons exposed to it are fully covered, as are the chemical, engineering, meteorological, and legal aspects of the problem. Theories on how stack dust and smoke are dispersed in relation to stack and building heights and how gas velocity, temperature, and other factors influence air pollution have been reduced to engineering terms for the first time. The book also discusses the ventilation of valleys and how smog is formed. The price of the publication for nonmembers of the Foundation is $2.00.

John Wiley & Sons, Inc., has published the twelfth edition of *Kent's Mechanical Engineers, Handbook* in two volumes dealing with power and with design and production, respectively. The first, made up of twenty sections, covers the field of heat-power engineering and transportation, as well as the more important aspects of fluid flow. The rapid advances in mechanical engineering during the past decade and more made it necessary to scrap much obsolete material, but despite deletions the book is some 20 percent larger than the previous volume. Space formerly given over to steam engines, gas producers, etc., is devoted to more modern and less widely understood subjects such as atomic power, combustion gas turbines, supersonics, marine engineering, jet propulsion, heat pumps, panel heating, diesel and electric locomotives, axial-flow compressors, and instrumentation. The work on design and production is intended primarily for designers and manufacturers of machinery, appliances, mechanical equipment, and other engineered products. It has been almost completely rewritten and is more than 300 pages longer than the preceding edition. Its 28 sections are broadly classified under the headings: Selection of Materials, Design Principles, Design and Selection of Machine Components, Production Processes, Production Plant Equipment, and Mathematical Tables. In presenting each subject an attempt has been made to give the engineer a quick grasp of the essentials, together with pertinent technical data in condensed form such as basic principles; working formulas, charts, and tables; standard dimensions, proportions, and specifications; and illustrated discussions of typical equipment. Copies of the handbooks can be obtained from the publisher at 440 Fourth Avenue, New York 16, N. Y. Price, $8.50 each.

Manufacturers of products that necessitate blind fastening or riveting can obtain a 20-page bulletin from The B. F. Goodrich Company, Akron, Ohio, on Rivnuts—one-piece blind rivets having threads for screw attachment that are widely used in metalworking and electrical industries. Booklet contains complete engineering and application data.

Basic reference data on compressed air and gas power has been compiled in booklet form by Compressed Air and Gas Institute. The three sections of the booklet cover uses of compressed air, theory of compressed air, and types of compressors. A copy can be obtained free of charge from the Committee on Engineering Education of the Institute at 1410 Terminal Tower, Cleveland 13, Ohio.

The resistance offered by nickel and its alloys to corrosion caused by caustic alkalies is the subject of a bulletin put out by International Nickel Company, Inc. It reports on the behavior of these materials in a variety of fields such as soda manufacture, transportation, and the making of viscose rayon, soap, pulp, paper, and petroleum products and includes instructions on descaling and cleaning preparatory to welding the metals. A copy can be had by writing to the company at 67 Wall Street, New York 5, N. Y., and asking for Bulletin T-6.

A folder that deals with a pocket-size device for testing fluorescent lighting fixtures can be had by writing to Ideal Industries, Inc., 1440 Park Avenue, Sycamore, Ill. The instrument is designed to locate the trouble and to indicate whether it is in the circuit, starter, or lamp. Two models are available to service fixtures having tubes in the 15- to 40-watt or the 85- to 100-watt range.

W. H. Nicholson & Company, 12 Oregon Street, Wilkes-Barre, Pa., will send upon request a copy of its Catalogue No. 250 which deals with traps and separators for steam, air, or gas. In addition to capacity tables and installation diagrams, the publication contains data, charts, and formulae that enable users to determine the proper size of trap for each specific application.

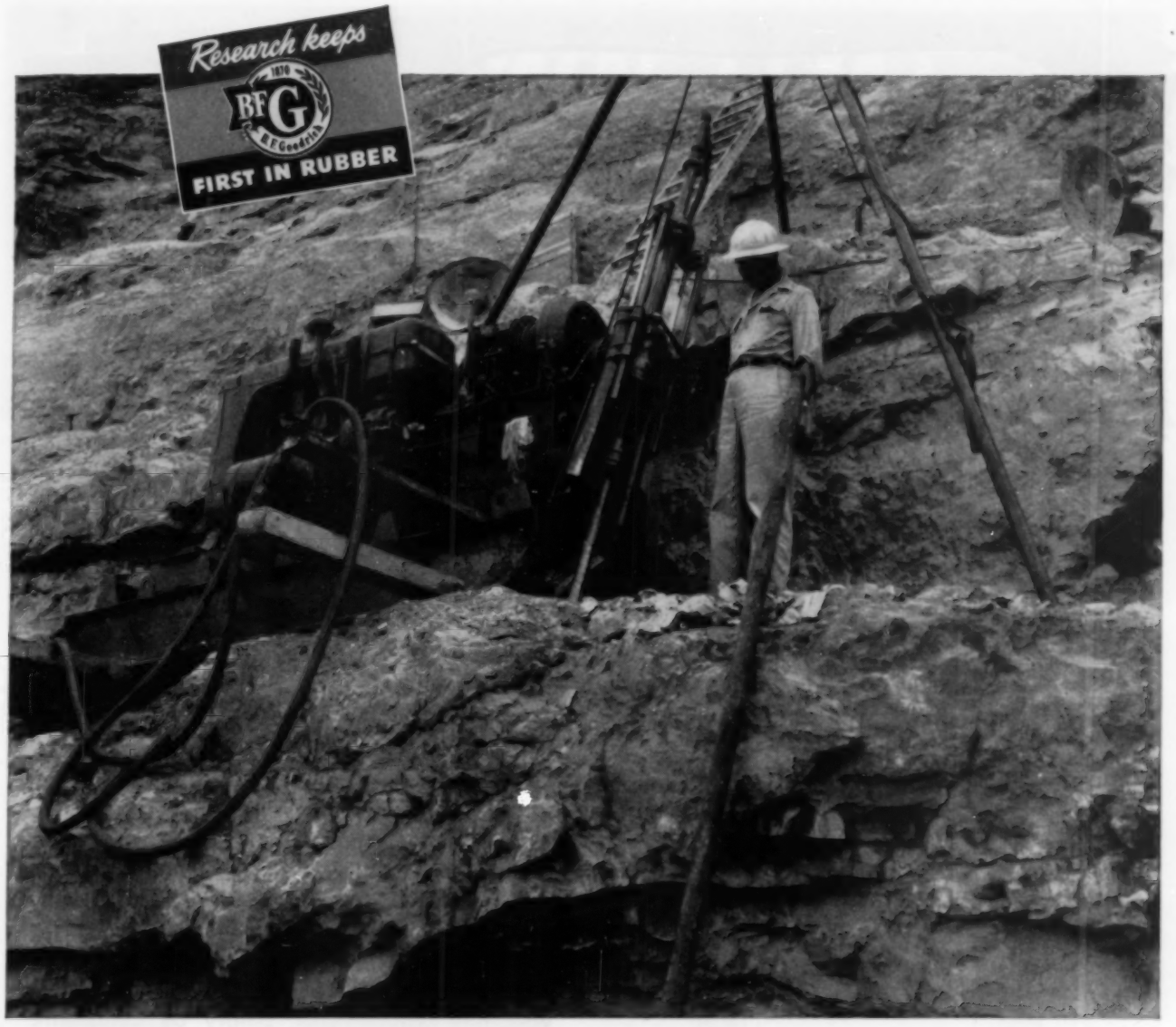
Procedures which cranemen and hitchers should follow to work safely and effectively are set forth in a 36-page pocket manual prepared by Allis-Chalmers Manufacturing Company, Milwaukee, Wis. Listing instructions they should follow, it also defines the extent of their authority and responsibilities. A copy is obtainable upon application to the company's health and safety department.

A bulletin on the proper handling and use of hydrogen-controlled welding electrodes can be obtained by writing to Arcos Corporation, 1500 South 50th Street, Philadelphia 43, Pa. Also available is literature dealing with three new additions to the firm's line of low-hydrogen electrodes which effect a time-saving in the welding of low alloy-high strength steels by the elimination of preheating.

A bulletin describing its new line of gear motors for speed reduction is obtainable from Abart Gear & Machine Company, 4828 West Sixteenth Street, Chicago 50, Ill. Standard speeds and ratios are as follows: Horsepower from 1/6 to 5; gear ratios from 5-4/5:1 to 100:1; and output speeds from 17.5 to 302 rpm. Motors are of the heavy-duty type. The bulletin gives sizes and ratings of single- and 3-phase models.

The sixth edition of a manual on steam hookups for steam traps, air vents, and industrial temperature controls can be had by writing to Sarco Company, Inc., Empire State Building, New York 1, N. Y. The publication is a handy source of information designed to help the user judge when and where steam traps or temperature controls are needed, what types and sizes to select, and how to install them properly.

Bulletin 2250 of Hagan Corporation describes a pneumatically operated instrument that measures differential pressures in the rate of flow of steam, gas, liquid fuel, water, and other fluids for indicating, recording, and control purposes. Its measuring range is from 100 inches water column to 25 psi. at static pressures up to 300 psig. It can also be used as a liquid flow meter. The bulletin will be sent upon request to the company at 323 Fourth Avenue, Pittsburgh, Pa.



Oil won't rot it, rock won't tear it
B. F. Goodrich air hose lasts for years

THAT'S B. F. Goodrich Type 50 air hose at left, used exclusively on this big construction job at Bull Shoals Dam in Arkansas. Here's why—

Oil-resisting—Oil destroys ordinary rubber; particles of the tube come loose, choke up tube and drill. B. F. Goodrich Type 50 air hose has an oil-resisting tube that won't break into loose, gummy particles. On jobs where, with hose of ordinary rubber, the hose had to be replaced every few weeks to save tools, B. F. Goodrich air hose lasted for years. The cover of Type 50 is oil-resisting too. Workers with oily hands or gloves can handle it, use it near oily machines and surfaces.

Tear-resisting—On a quarry job like this, hose is always in danger of costly tears, breaks, snags. B. F. Goodrich engineers developed a special abrasion-resisting cover for air hose. Scraping over rock, rough floors, cinders, roads won't tear it. Won't check or crack from constant sunlight.

Recommended Services—B. F. Goodrich Type 50 air hose is recommended for shop tools, tie tamping, light and heavy portable compressors, air hoists, ore mining and quarry service.

B. F. Goodrich makes an air hose for every purpose, from small shop tool to big construction machinery . . . for small oil and air lines, heavy duty service in mines and quarries, for inside shops where oily conditions would rot ordinary hose, outdoor compressor service, air drills and pneumatic tools.

Your local BFG distributor has all the details and prices on these and other B. F. Goodrich air hose, many with features found only in hose made by B. F. Goodrich. Give him a call, or write *The B. F. Goodrich Company, Industrial and General Products Division, Akron, Ohio.*

Air Hose BY

B.F.Goodrich

"When you are faced with a problem of ring breakage, Cook engineers first determine the cause, suggest corrective measures and then recommend the rings that will give the best service under your particular engine and operating conditions.

"This is not as simple as it sounds. Ring breakage is usually due to a combination of interrelated factors, just a few of which might include, groove condition, injection timing, compression pressures, cetane rating of the fuel and the type of rings used.

"But, having electronically indicated most standard engines under all conditions of service, Cook engineers can undertake such an analysis on a sound and scientific basis. As a result, their recommendations pay off in long, trouble-free Diesel service."

You can get a "job-engineered" survey of your ring requirements, simply by contacting the nearest Cook field office. Do it today—there's no obligation.

C. Lee Cook Mfg. Co., Incorporated, Louisville, Ky. Branch offices in Baltimore, Boston, Chicago, Cleveland, Houston, Los Angeles, Mobile, New Orleans, New York, San Francisco, and Tulsa.

COOK GRAPHITIC IRON PISTON RINGS

. . . SEALING PRESSURES SINCE 1888 . . .

Avoid "DOWN-TIME" for Maintenance—Standardize on the POWELL LINE

Fig. 95—Bronze Dash Pot Check Valve for 200 pounds air working pressure. Designed for air compressor service. Has screwed ends, screwed-on cap and regrindable, renewable, wear-resisting bronze disc. Cushioning effect of plunger in dash pot makes seating of disc practically noiseless.

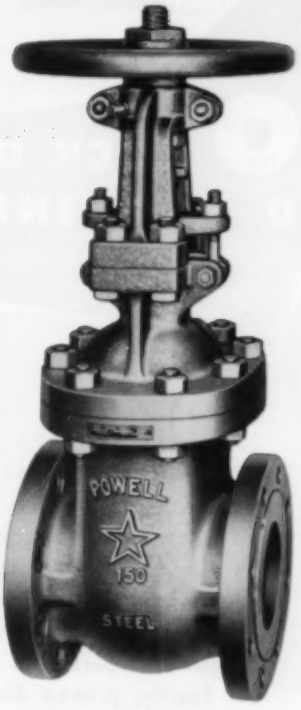


Fig. 1503 — Class 150-pound Cast Steel Gate Valve with flanged ends, outside screw rising stem, bolted flanged yoke, tapered solid wedge.

When you buy a valve, ask yourself these two questions. First, will it operate satisfactorily in the service in which it is to be used? Second, and of most importance, how much *maintenance* will it require? Because, every time maintenance becomes necessary, there's a two-fold cost. One, the cost of labor—and possibly parts—to put it back in working order. Two, the loss of production farther down the line.

And, because Powell Engineers *always* have this in mind, every valve in the *complete* Powell Line* is designed and made to avoid, as far as possible, "DOWN-TIME" for maintenance.

That's why, through the years, Powell Valves have been noted for long, trouble-free performance—even under the most exacting service conditions.

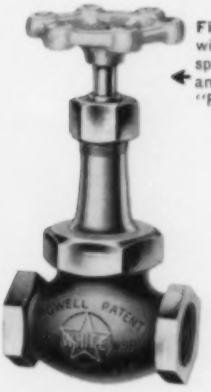


Fig. 1708 — 200-pound Bronze Globe Valve with screwed ends, union bonnet, renewable, specially heat-treated stainless steel seat and regrindable, renewable, wear-resisting "Powellium" nickel-bronze disc.

Fig. 1793 — Large 125-pound Iron Body Bronze Mounted Gate Valve with flanged ends, bolted flanged yoke, outside screw rising stem and tapered solid wedge.

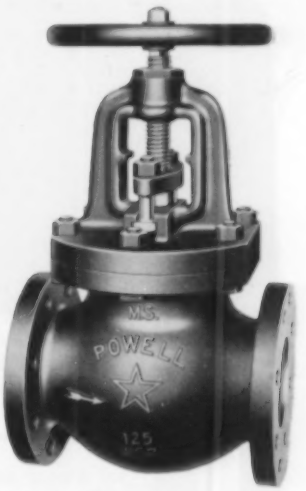


Fig. 241 — 125-pound Iron Body Bronze Mounted Globe Valve with outside screw rising stem bolted flanged yoke, regrindable, renewable bronze seat and disc.

*The Complete Powell Line includes Globe, Angle, "Y", Gate, Check, Non-return, Relief, and Flush Bottom Tank Valves in Bronze, Iron, Steel and a wide range of Corrosion-resistant metals and alloys.

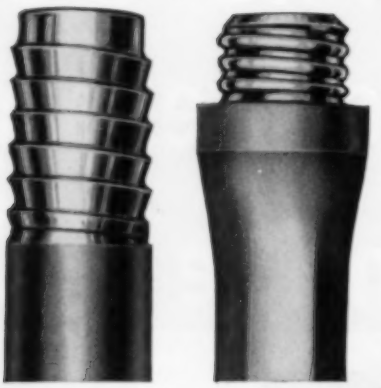
Ask your nearest Distributor—or write direct

The WM. POWELL Co., 2525 Spring Grove Ave.
P. O. Box 106, Station B, Cincinnati 22, Ohio
DISTRIBUTORS AND STOCKS IN ALL PRINCIPAL CITIES

POWELL VALVES

Keep 'em Drilling

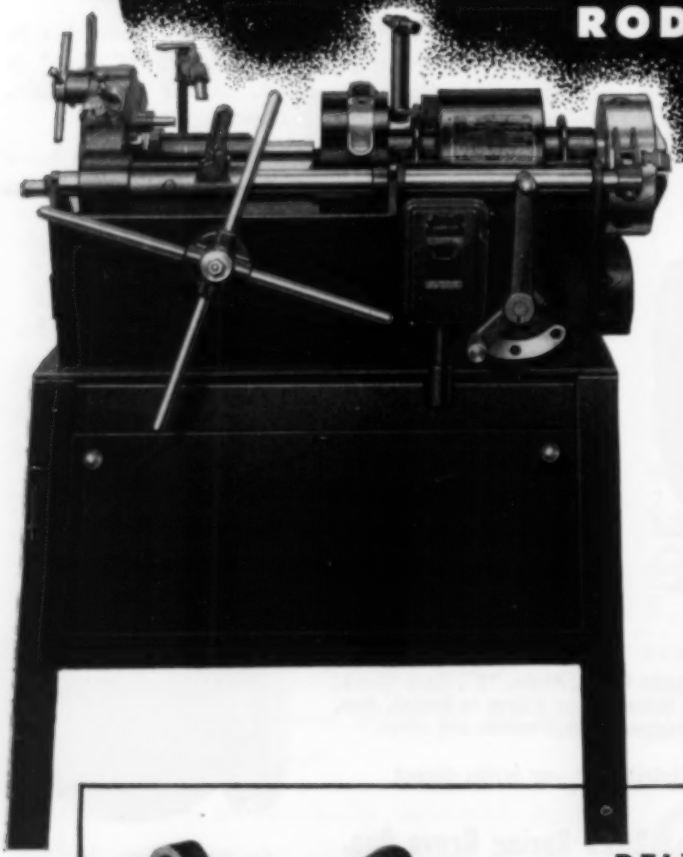
AT MINIMUM COST!



thread your drill rod

ON THE JOB

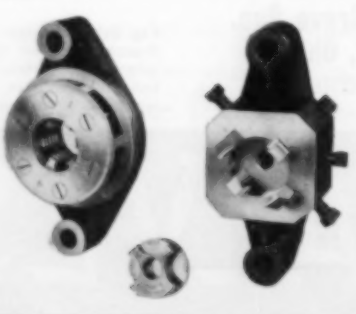
with a TOLEDO ROCK DRILL ROD MACHINE



Keep your drill rod in service *at minimum cost*—use a TOLEDO 2″ High Speed Rock Drill Machine! Will thread new or re-thread broken drill rod *right on the job*—at a fraction of the cost of a new rod. Reduces downtime and expense.

Can be tooled to produce Ingersoll-Rand and Timken threads. After rod is annealed the Toledo Machine will turn to size, thread and face off end of rod to a perfect fit for detachable bits.

Sturdy, proven design . . . simple operation. Multiple disc clutch. Chain drive, fully enclosed. Two chucks. Round renewable ways. All steel construction. Centrifugal oil pump. All gears run in oil bath. Segmental dies and tools can be reground for additional service when dull. Send today for complete details. The Toledo Pipe Threading Machine Co., Toledo Ohio. New York Office: 165 Broadway, Room 1310.



Die head and dies, tool box and cutters for turning and forming Timken rods, and special stop for setting the cutters to size are shown here.

RELY ON THE LEADER

TOLEDO

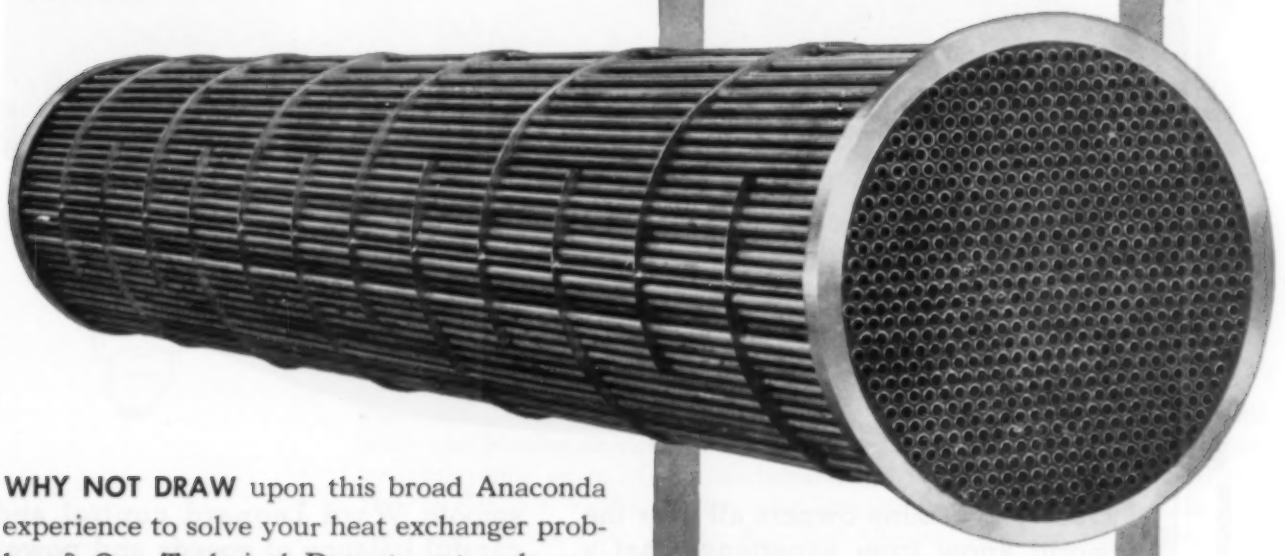
for ROCK DRILL ROD MACHINES

Is your heat exchanger tube and sheet problem

Different? Tougher?

It may seem so to you—but it may not be so to us!

OVER THE YEARS, our Technical Department has helped many users of heat exchangers... studied their particular problems... suggested materials... checked on the results. In the end, the best answer to each problem has gone into our files, ready for use when a similar problem arises.



WHY NOT DRAW upon this broad Anaconda experience to solve your heat exchanger problems? Our Technical Department welcomes the opportunity to place it at your service. If you don't already have a copy, let us send you "ANACONDA Tubes and Plates for Condensers and Heat Exchangers." Just ask for Publication B-2. The American Brass Company, Waterbury 20, Connecticut. In Canada: Anaconda American Brass Limited, New Toronto, Ont.

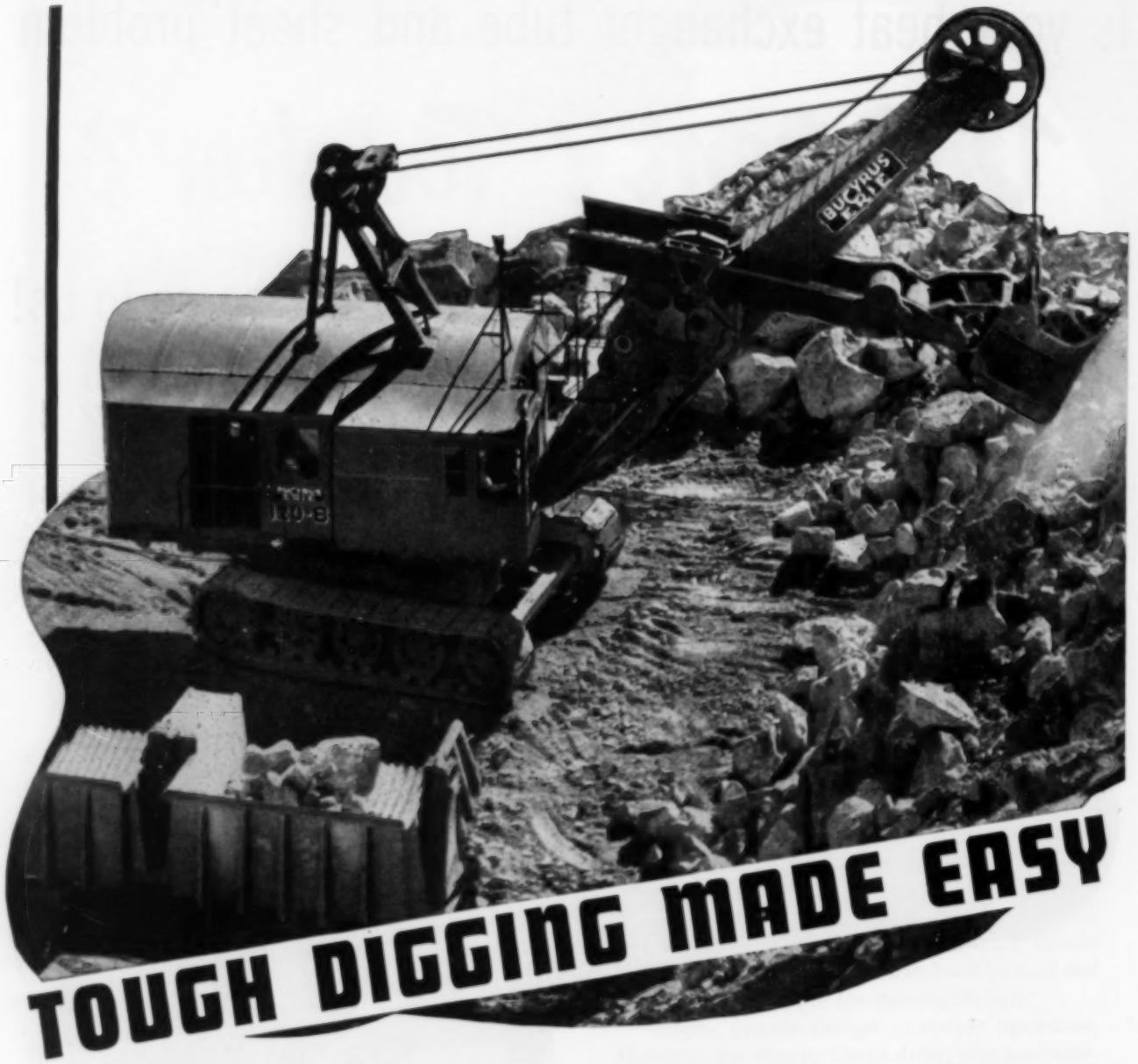
50118

UPPER PHOTO shows Adams two-shell, single stage aftercooler designed to control temperature of compressed air and to condense water and oil vapors present. The condensate is removed by a separator. Built by R. P. Adams Company, Inc., Buffalo, N. Y.

LOWER PHOTO shows tube bundle for aftercooler. ANACONDA Arsenical Admiralty Tubes, Muntz Metal Tube Sheets and Brass Baffles.

For efficient heat transfer **ANACONDA®**

HEAT EXCHANGER TUBES



TOUGH DIGGING MADE EASY

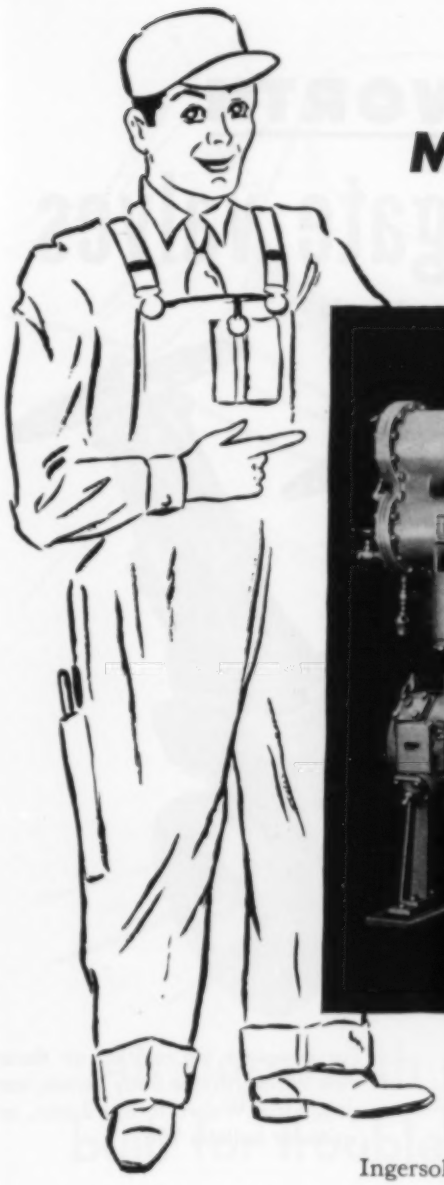
Quarry and mine owners all over the world know from experience that a Bucyrus-Erie excavator is their best assurance of dependable high output combined with on-the-job reliability through years of service. The 5 cu. yd. 120-B is a typical example of Bucyrus-Erie *years ahead* design, from its hard-digging dipper with tough manganese steel lip to its ground-gripping treads, heat-treated to withstand wear. Its smooth Ward Leonard control and careful balance of speeds and power give the operator complete mastery of every function for a speedy, output-boosting cycle.

With capacities from ⅜ to 36 cu. yds., there is a Bucyrus-Erie to fit any quarry or mine requirement, and to meet production demands with fast, smooth, economical operation.

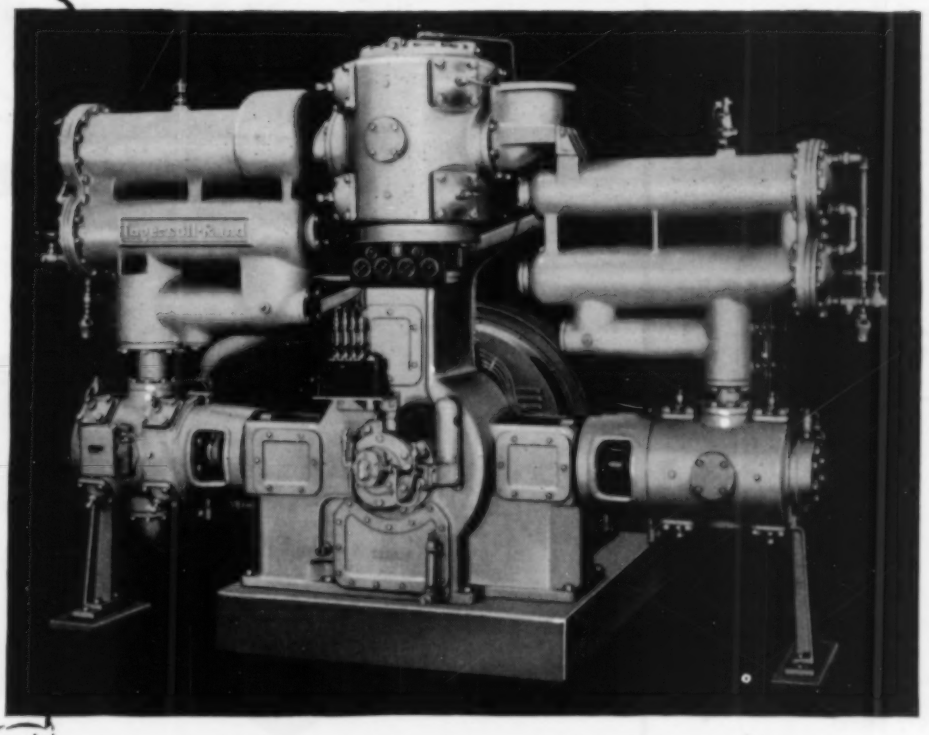
105L50

BUCYRUS ERIE

SOUTH MILWAUKEE, WISCONSIN



MASTER OF MANY TRADES



bearings engineered by SKF

Ingersoll-Rand's 3-stage TVH Heavy-duty Compressors are widely used for boiler soot-blowing service, for handling gases where leakage must be avoided, for compressing air in oxygen production, and in scores of other applications. They're compact, highly efficient, give long-life heavy-duty service. The two main bearings are SKF Double-Row Self-Aligning Spherical Roller Bearings. They require no adjustment . . . are engineered and built to withstand heavy radial and thrust loads. SKF specializes in supplying the bearing that's right for the job . . . the bearing that keeps friction at a minimum and makes important contributions to long-term trouble-free operation. SKF Engineers will work with you in helping you design for greater efficiency and lower operating costs. **SKF** INDUSTRIES, INC., PHILADELPHIA 32, PA., *the Pioneers of the Deep Groove Ball Bearing – Spherical Roller Bearing – Self-Aligning Ball Bearing.*

7105

SKF

BALL AND ROLLER BEARINGS

8 REASONS WHY **SKF** IS PREFERRED BY ALL INDUSTRY

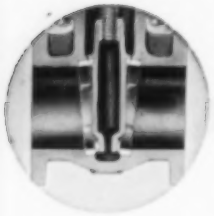
Integrity — Craftsmanship — Metallurgy — Tolerance Control

Surface Finish — Product Uniformity — Engineering Service — Field Service

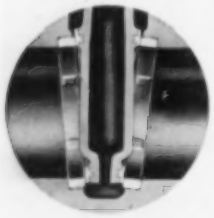
WALWORTH

iron body gate valves

with screwed or flanged ends



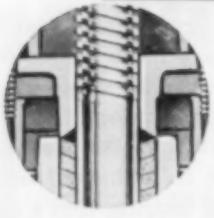
Straight-Flow Port Design reduces fluid turbulence to a practical minimum.



Seat Rings of end-seated type are screwed into the body.

Sure-Grip Malleable Handwheel for non-skid gripping even with heavy gloves.

... 8 Outstanding Features



Brass Liner on Glands assures greater resistance to corrosion and scoring.

For complete information on these new Walworth Iron Body Valves, see your local Walworth distributor, or write for bulletin 106.

WALWORTH

valves and fittings

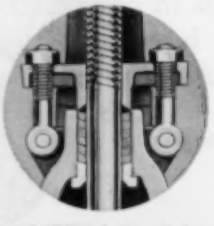
60 EAST 42nd STREET NEW YORK 17, N. Y.

DISTRIBUTORS IN PRINCIPAL CENTERS THROUGHOUT THE WORLD

T-head Disc-to-Stem connection on OS&Y types provides stronger connection, prevents loosening of disc by corrosion.

Bronze Back-Seat Bushings in bonnets of OS&Y valves.

Solid Web Type Disc in OS&Y valves for greater strength and longer service.



Hinged Gland Eye-Bolts on OS&Y valves permit faster, easier repacking under full pressure.

Air hose with cover and tube of NEOPRENE built for trouble-free service in machine shops

Shops and factories are no place for air hose that can't take it—operating conditions are rough! But here's a hose you can depend on for long, dependable service *anywhere*. It's protected inside and out with durable neoprene.

The cover of neoprene withstands exposure to sunlight, ozone, heat and oil . . . doesn't crack or soften. It remains tough and durable—resists abrasion and cutting—continues to protect the fabric reinforcement long after these conditions have weakened on ordinary rubber hose cover to the point where it fails.

The neoprene tube won't disintegrate when exposed to lubricating oil. So no crumbled particles or chunks will be carried along to clog tools. Neoprene resists oil and heat, remains tough, delivers long, leak-proof service.

So for minimum maintenance costs, and maximum efficient, trouble-free service, ask your supplier for quality air hose made with tube and cover of Du Pont neoprene. E. I. du Pont de Nemours & Co. (Inc.), Rubber Chemicals Division, Wilmington 98, Delaware.

NEOPRENE PREVENTS TROUBLE LIKE THIS!

Particles of ordinary rubber have disintegrated from oil and heat and clogged the strainer of this filter. The result is a shutdown, and shortened service life of the air hose.

NEOPRENE

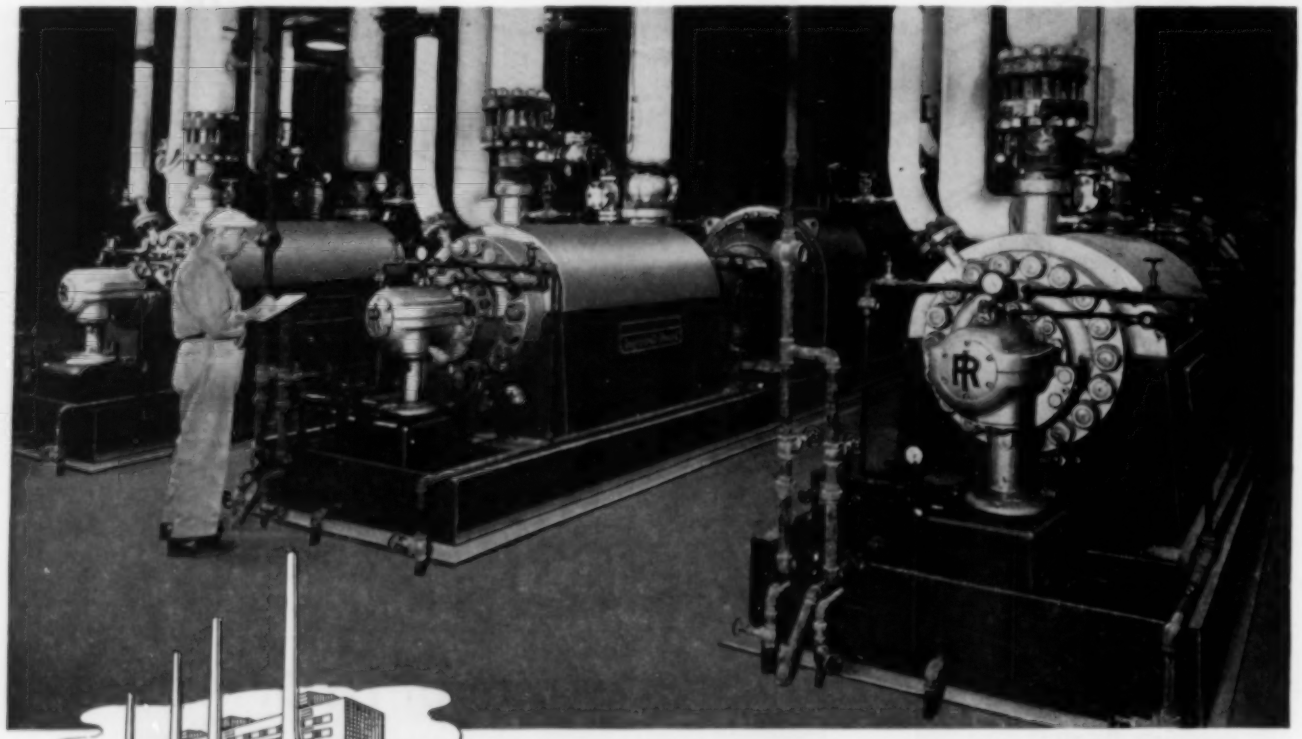
The rubber made by Du Pont since 1932

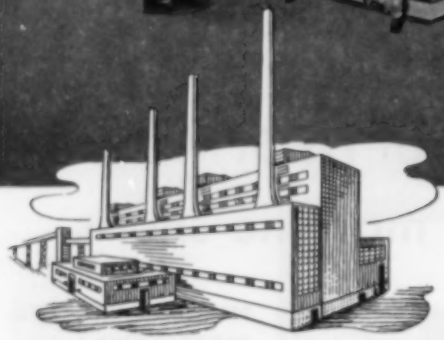
DU PONT

REG. U. S. PAT. OFF.

BETTER THINGS FOR BETTER LIVING . . . THROUGH CHEMISTRY

NEW PHILIP SPORN STATION TO INSTALL 24,000 HP OF I-R BOILER-FEED PUMPS





Twelve Ingersoll-Rand "double case" pumps, operating at 2395 psi, will handle all boiler-feed water for the four 150,000 kw units

This new high-pressure steam generating plant, named in honor of Philip Sporn, president of the American Gas and Electric Company, will serve the company's vast interconnected system in the seven states of Michigan, Indiana, Ohio, Virginia, West Virginia, Kentucky, and Tennessee. Designed by and constructed under supervision of the American Gas and Electric Service Corporation, it will eventually make available 900,000 kw of net output capability to meet the system's rapidly increasing demands for electric power.

The new Philip Sporn Station of the American Gas and Electric Company System, near New Haven, West Virginia, represents the last word in steam plant design. The first generating unit with a net output capability of 150,000 kw, went into commercial operation in January 1950. Three additional units, which are already under construction, will bring the plant net output capability to 600,000 kw.

Each of these four generating units will be served by three Ingersoll-Rand Class CHTA, 11-stage, "double case" pumps—two for full load requirements, and the third for stand-by service. Three of these feed pumps are shown above, direct connected to 2000 hp, 3570 rpm motors. Each pump is designed to handle 1100 gallons per minute, at 2395 psi and 304° F.

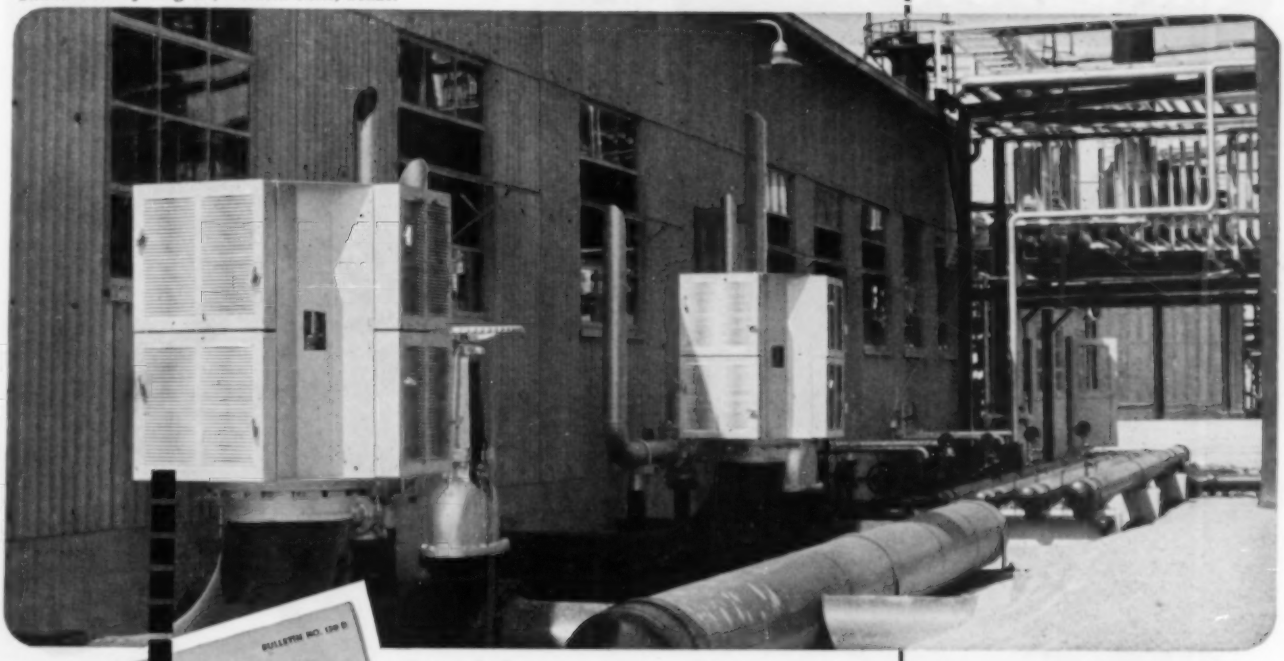
Here, as in all high-pressure steam plants, the accent is on *dependability and continuity of service.* And Ingersoll-Rand boiler-feed pumps have repeatedly proved their ability to stay on the job year after year under the most severe operation conditions. That's why they're *first choice* for really high pressure service.

PUMPS • COMPRESSORS
AIR AND ELECTRIC TOOLS
DIESEL ENGINES • ROCK DRILLS
VACUUM EQUIPMENT • CONDENSERS

Ingersoll-Rand
11 BROADWAY, NEW YORK 4, N. Y. 537-10

These "Cats" get Longer Life

Panhandle Refining Co., Wichita Falls, Texas.



Engineered Air cuts refiners' costs

REFINING petroleum, just as the term implies, means getting rid of impurities. Even the catalytic compounds have to be kept clean and that meant frequent replacement of catalysts . . . expensive but necessary.

Engineers reasoned a good way to stop contamination of costly catalysts was to catch dirt at the start—capture it at the air intake.

Because AAF makes every kind of air filter, expressly for particular air cleaning problems, those catalysts have longer life now. In the picture above you see AAF Type OCH on the job. Six units in the housing behind those weather louvres maintain a strict "keep out" attitude toward air borne dirt. Filters can be taken out, cleaned quickly and replaced.

The catalytic process functions better with clean air. The catalytic compound stays in service far longer, saving dollars for the refiner.

AAF equipment can be on the job for you. Why not call in the air experts, let AAF find a "profit in the air" for you. Just write to the address below.

HERE'S A QUICK TEST IN GOOD MANAGEMENT FOR YOU

Where can you stop a dollar loss? Is dirt in your engines, in your plant, on your product, costing you money? Check up right now. See how you can profit from clean air.

AIR FILTERS

AND DUST CONTROL EQUIPMENT

AAF

American Air Filter

COMPANY, INC.

402 Central Avenue, Louisville 8, Ky., *In Canada: Darling Bros., Ltd., Montreal, P. Q.*

MADISON-KIPP *Fresh Oil* LUBRICATORS

. . . provide the most dependable method of lubrication ever developed

Oil under pressure fed drop by drop from a Madison-Kipp Lubricator will definitely increase the production potential for years to come when applied as original equipment on new machine tools, work engines, and compressors. There are six popular models for every application. Write for special engineering data for your particular requirement.

MADISON-KIPP CORPORATION

202 WAUBESA STREET, MADISON 10, WIS., U.S.A.

ANCIENS ATELIERS GASQUY, 31 Rue du Marais, Brussels, Belgium, sole agents for Belgium, Holland, France, and Switzerland.

WM. COULTHARD & CO. Ltd., Carlisle, England, sole agents for England, most European countries, India, Australia, and New Zealand.

- Skilled in DIE CASTING Mechanics
- Experienced in LUBRICATION Engineering
- Originators of Really High Speed AIR TOOLS

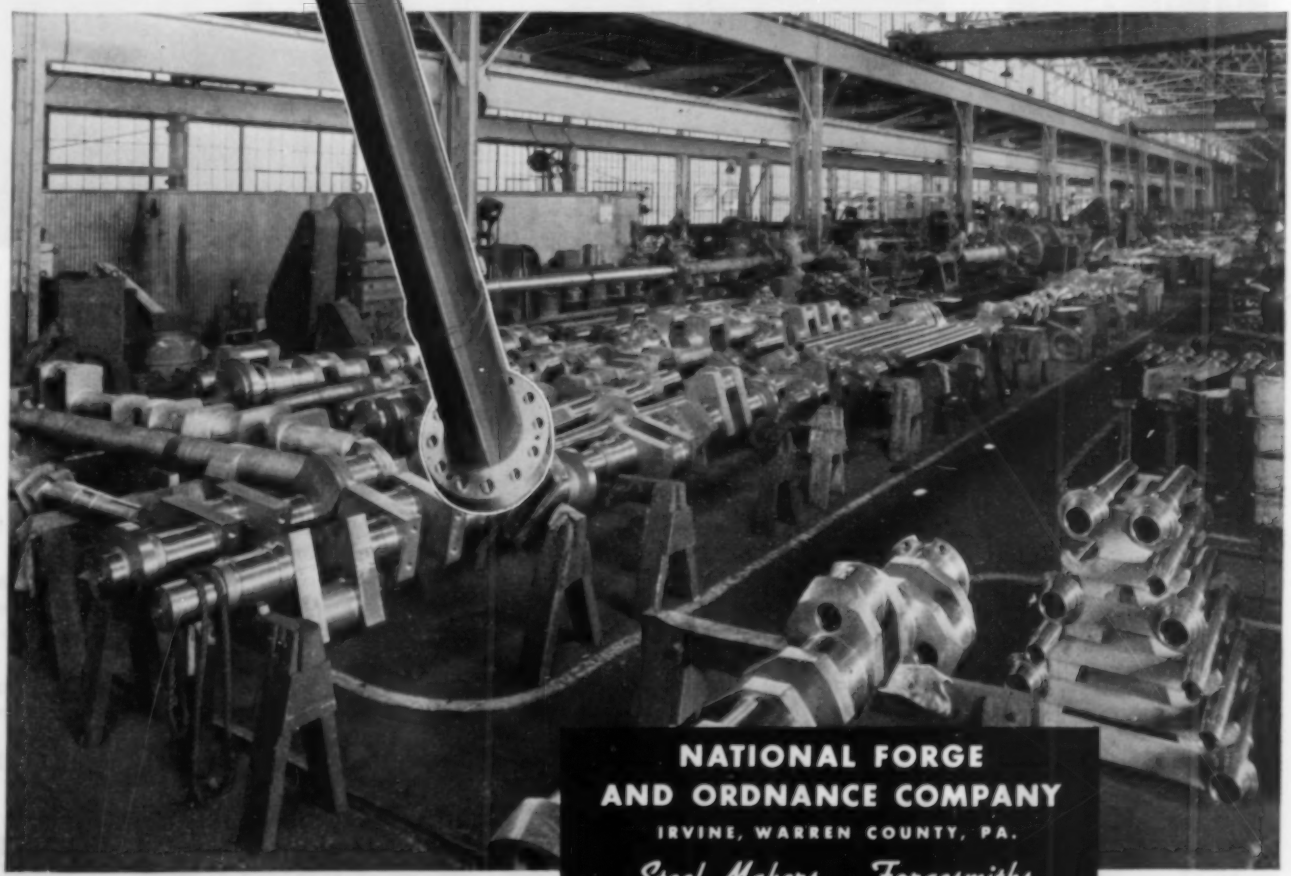
FINISHED FORGINGS and ASSEMBLIES

Ready for Installation

20,800 lb. Turbine Generator Shaft. Length . . . 23′ 8.8″ Total allowable run out on bearings, flanges, pilots, etc. .001″

National Forge offers you a complete service, under one responsibility, from making basic electric steel to the finish machining and assembly of your forged machine parts.

May we quote on your requirements?

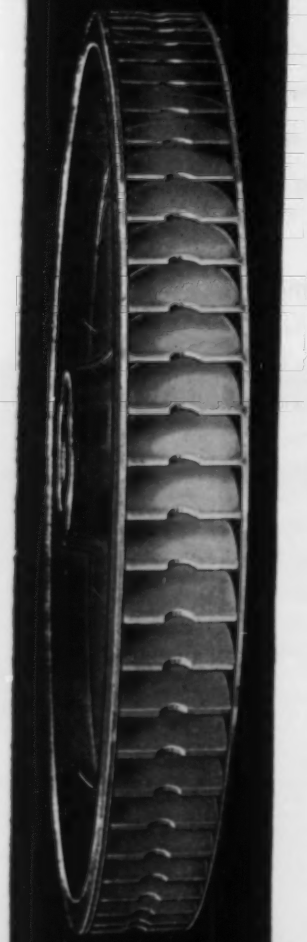


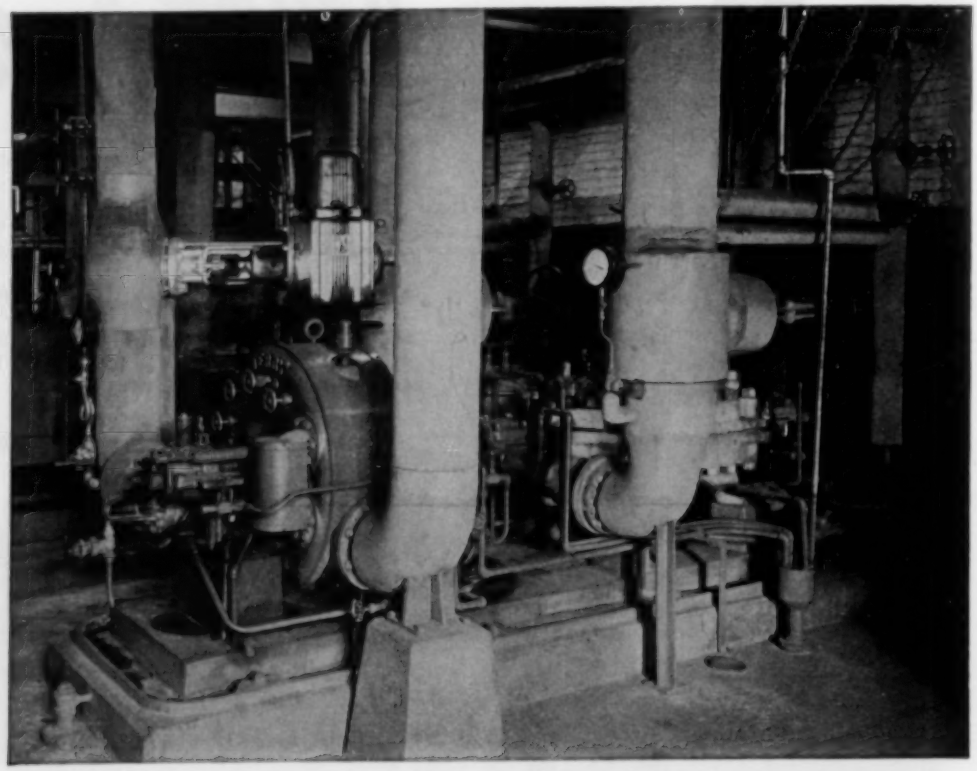
NATIONAL FORGE AND ORDNANCE COMPANY

IRVINE, WARREN COUNTY, PA.

Steel Makers · Forgesmiths
Heat Treaters · Machinists
Machinery & Testing Equipment Manufacturers

TERRY





This 600 hp high pressure, high temperature Terry Turbine is used to drive a boiler feed pump.

WHY
AMPLE BLADE CLEARANCES ARE SO IMPORTANT

This Terry Turbine has large radial and axial clearances.

If radial clearance should become reduced, the blades are protected by projecting rims at sides.

The side clearance — one inch — is so large that possible end play from excessive external thrust can cause no damage to the wheel. And frequent inspection of thrust bearings is unnecessary.

Write us on your business letterhead for a copy of Terry Bulletin S-116 describing these construction features and other Terry advantages.

Our district representative will be glad to discuss your specific turbine drive problem with you.

T-1173

THE TERRY STEAM TURBINE COMPANY
TERRY SQUARE, HARTFORD, CONN.

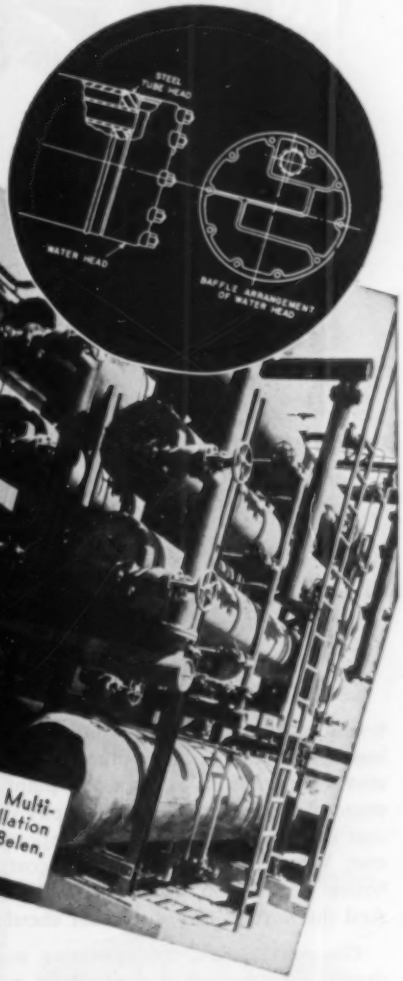
$ave Power and REFRIGERATION COST

Vogt Condensers, because of their correct design, STEP UP the rate of heat transfer and STEP DOWN head pressures. With the liquid delivered at a lower temperature, smaller compressor capacity is needed, saving in original as well as operating costs.

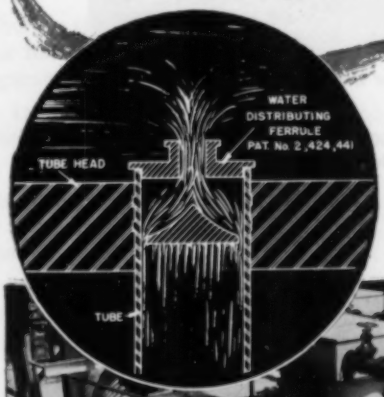
One of the two basic types illustrated will fit your operations exactly. Install Horizontal Multipass (closed type) for use with clean waters. Where the water is hard, forms scale, contains mud or promotes fungus growth, Vertical Single Pass (film type) which can be cleaned in operation, are recommended.

Horizontal Multipass Condensers
(Closed Type)

Water circulated in tubes traverses the length of the unit a number of times as determined by baffles in the heads.

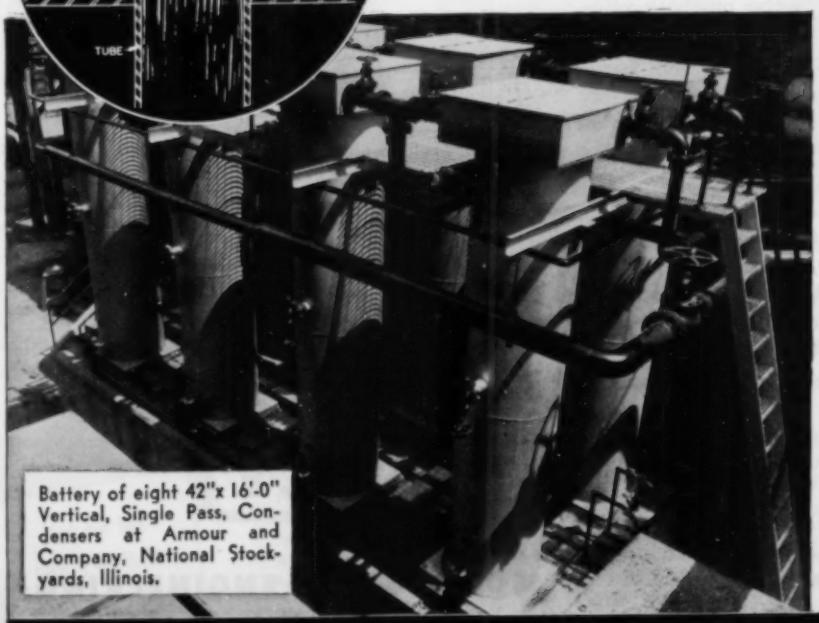


375 tons capacity Multi-pass Condenser installation at Railways Ice Co., Belen, New Mexico.



Vertical Single Pass Condensers
(Film Type)

Patented ferrules give equal distribution of water to and over the surfaces of all tubes in a unit.



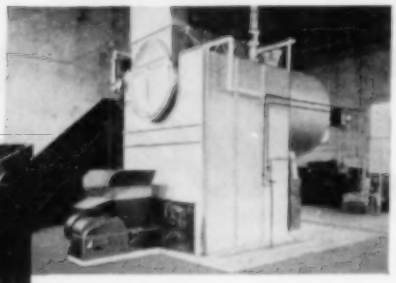
Battery of eight 42"x 16'-0" Vertical, Single Pass, Condensers at Armour and Company, National Stockyards, Illinois.

HORIZONTAL and VERTICAL TYPES SHELL and TUBE CONDENSERS For Every Service

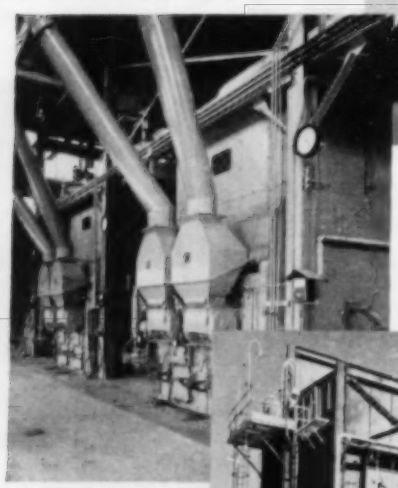
Write For Bulletin RC-1

HENRY VOGT MACHINE COMPANY
INCORPORATED
1000 W. ORMSBY ST., LOUISVILLE 10, KY., U.S.A.
Branch Offices: NEW YORK, CHICAGO, CLEVELAND, DALLAS, PHILADELPHIA, ST. LOUIS, CHARLESTON, W. VA.

Vogt REFRIGERATION CONDENSERS

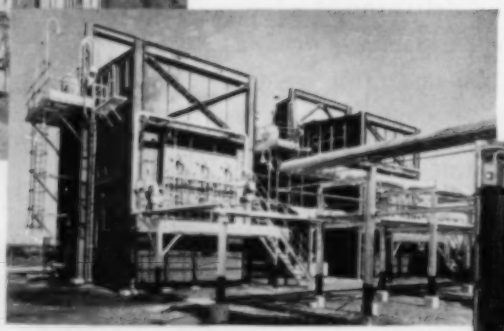


Installation for small plants . . . pressure up to 150 psi . . . capacity to 12,000 lbs. of steam per hr . . . adaptable to any fuel.

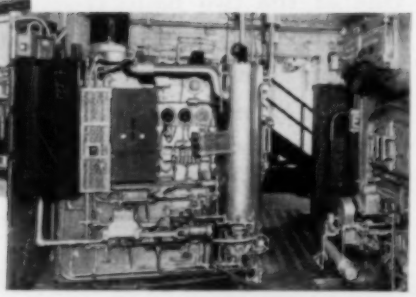


Planning to buy BOILERS ... this year ... next year

Installation for medium and smaller plants . . . pressure to 475 psi . . . capacity to 60,000 lbs. of steam per hr . . . suitable for any type of fuel.



Installation for larger plants . . . pressure to 1000 psi . . . temperature to 900 F . . . capacity to 350,000 lbs. per hr . . . any fuel or type of firing . . . indoor or outdoor type construction.



Installation for special conditions including very limited space . . . quick steaming (full capacity in 3 min.) . . . fully automatic operation . . . capacity to 6000 lbs. of steam per hr . . . pressure to 300 psi. Ideal for intermittent load.

Sometime this year, or perhaps next, your company may decide to buy new boilers . . . to replace obsolete units . . . to meet increasing steam demands . . . or for a new plant. Whatever the time or circumstances, here's something it will pay you to remember. The operating cost of a boiler is a far more important consideration than its first cost. Why? Because the *annual* cost of fuel *alone* for the average boiler installation usually equals or exceeds the purchase price. And the normal life of a boiler should be 20 to 30 years, or longer.

Obviously, then, the operating economies accruing from better design, construction or application, will quickly offset the difference between the cheapest boiler you can buy and the best the market affords. Here is one case where the old adage "the best is the cheapest" really applies.

In addition to having installed thousands of industrial boilers . . . in every size category from less than 100 horsepower up . . . Combustion has designed and built many of the country's largest utility power station boilers. And it is in this field – the manufacturing of power on a large scale – that boiler design and construction are evaluated most critically and exhaustively.

The fact that C-E Boilers have been selected to meet the exacting performance standards of so many of the nation's largest utility power stations is evidence of the quality of design and construction you can expect to find in any boiler, large or small, that bears the Combustion nameplate.

Our recommendations as to the most suitable type of boiler and firing equipment for the *specific requirements* of your next installation are available to you and your consultants without obligation.

B-383

C-E

COMBUSTION ENGINEERING—SUPERHEATER, INC.

200 Madison Avenue • New York 16, N. Y.

ALL TYPES OF STEAM GENERATING, FUEL BURNING AND RELATED EQUIPMENT

Your air compressor can't help pumping water

. . . but you can keep that water out of your air-operated equipment

Prolong the life of pneumatic tools and air lines . . . improve operation of air-operated instruments . . .

Dry your compressed air with Cuno MICRO-KLEAN Air Line Filters.

It's a fact—for every 1000 feet of free air per minute your compressor delivers, it also pumps an average of 70 to 80 gallons of water vapor every 8-hour day.

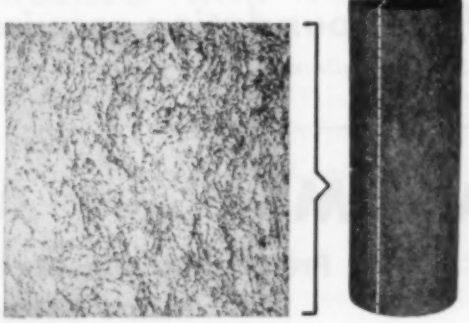
That's why many manufacturers of air-operated products install Cuno MICRO-KLEAN as standard equipment.

It Gets Out All The Moisture—Dirt, too

MICRO-KLEAN removes *all* entrained moisture together with all foreign particles—dirt, pipe scale, etc.—down to 1 micron size.

Double dirt capacity—due to an exclusive construction feature—means half the cartridge replacement cost is saved. Resinous impregnation and polymerization eliminates "wicking" and strengthens the cartridge, preventing channeling.

Air passing into filter hits baffle, which deflects some moisture down outside cartridge. Any moisture remaining . . .



. . . enters cartridge where it must work its way through a network of tiny interstices, making hundreds of sharp turns and impinging, sooner or later, on non-wicking fibres. Then it drains into the extra-large collection chamber.

No Fluid Is Better than Its Filtration

CUNO

Complete Line

Fluid Conditioning

Removes More Sizes of Solids from More Types of Fluids

MICRONIC (Micro-Klean) • DISC-TYPE (Auto-Klean)
WIRE-WOUND (Flo-Klean)

Find out how little it costs to **MICRO-KLEAN** Your Compressed Air

- ☐ Air Hoists
- ☐ Pneumatic Tools
- ☐ Sand Blast Equipment
- ☐ Spray Paint Lines
- ☐ Air Guns
- ☐ Racking and Bottling Equipment
- ☐ Air Operated Temperature and Pressure Instruments
- ☐ Air Operated Vulcanizing Changers
- ☐ Air Operated Presses
- ☐ Air Brake Systems
- ☐ Compressor Suction Unloaders
- ☐ Air Operated Cotton Pickers
- ☐ Air Operated Glass Blowing Equipment
- ☐ Air Operations for cleaning and testing rubber goods
- ☐ Air Operated Elevator Doors

Any other compressed air service.....

Any other gas.....

CUNO ENGINEERING CORPORATION
1719 South Vine Street, Meriden, Conn.

Please send me a free copy of your MICRO-KLEAN Air Line Filter Bulletin. I am especially interested in the services checked.

Name.....Title.....

Company.....

Address.....

City.....State.....

PLEASE ATTACH COUPON TO YOUR BUSINESS LETTERHEAD

Complete Conditioning of Compressed Air

by ADAMS PIPELINE

AFTER COOLER and AIR FILTER

Thousands in use in Leading Industries
RESULTS GUARANTEED

ADAMS Aftercooler and Cyclone Separator

ACTION

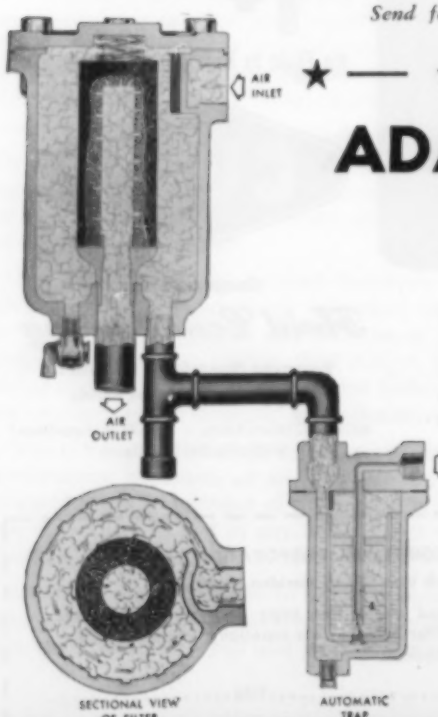
- Cools compressed air to within a few degrees of cooling water
- Through this cooling, vaporized water and oil are condensed — and completely removed by Cyclone Separator

BENEFITS

- The dry, clean air prevents failing of instruments
- Reduces wear and tear on air tools and pneumatic machinery
- Prevents freezing pipes in winter
- Prevents rust and pipe scale in distribution lines

Easy to install, no foundation required

Send for Bulletin 704



ADAMS PORO STONE Air Filters

Protect Instruments and Air Tools —Insure Better Work

The Adams Poro-Stone Filter gives continuous service without attention or maintenance expense. Efficient centrifugal separation *plus* diffusion through Poro-Stone, removes liquid and solid contamination completely without pressure loss.

Automatic Trap eliminates attention and assures continuous and efficient filter operation.

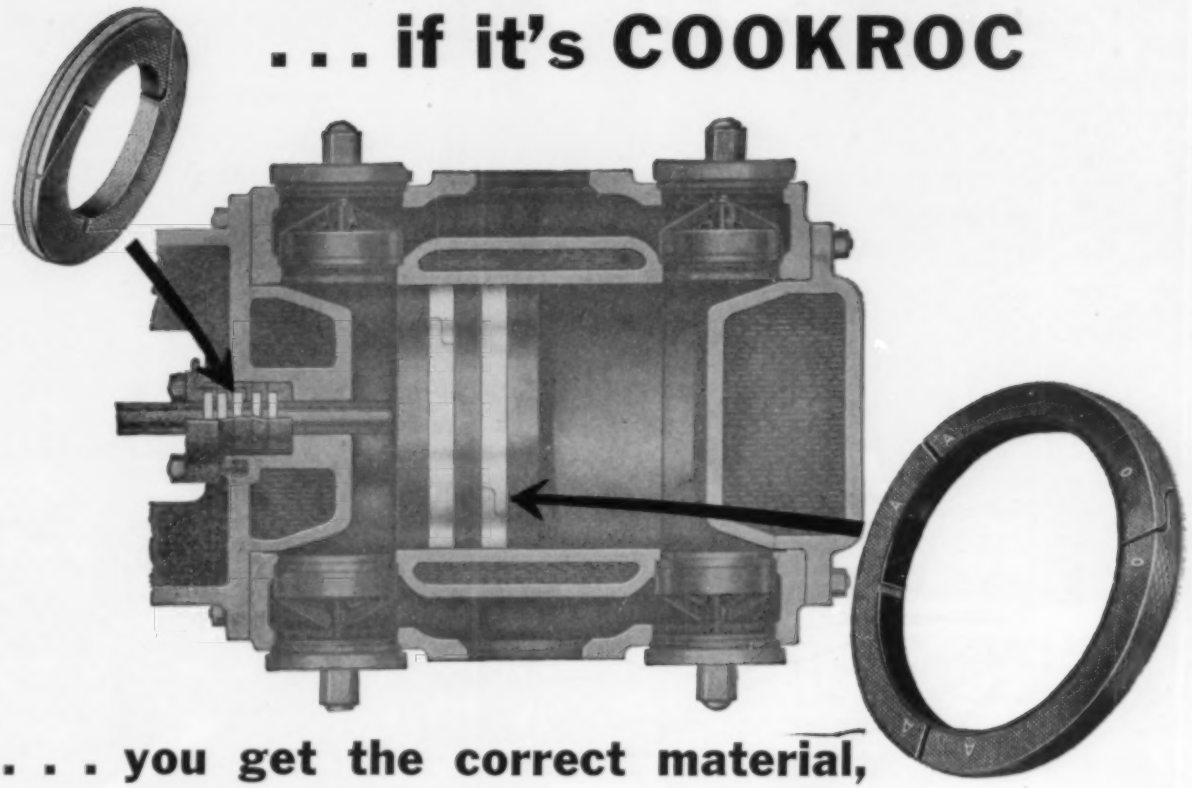
Learn how Adams Conditioning means Trouble-free use of Compressed Air

Send for Bulletin 105, and accept our 30-day FREE TRIAL on ADAMS Poro-Stone Air Filters.

R. P. ADAMS CO., INC.

209 E. PARK DRIVE
BUFFALO 17, N. Y.

You take no chances ... if it's COOKROC



. . . you get the correct material, precision manufacture and results

Selecting the most suitable ring material for a particular gas condition will always be a big problem for compressor operators. The point is, there is no single foolproof formula for every condition encountered.

Because of this, Cook has developed a wide range of ferrous, non-ferrous and non-metallic materials from which to select.

Take COOKROC. This laminated Bakelite base material is compounded especially for compressors handling gases carrying a high H_2S concentration, or gases laden with hydro-carbon vapors. It comes in several forms: Standard, Graphitized and High Temp. Standard size rings, stocked at Cook's plant in Louisville and its agents' Mid-Continent and California warehouses, are subject to immediate shipment.

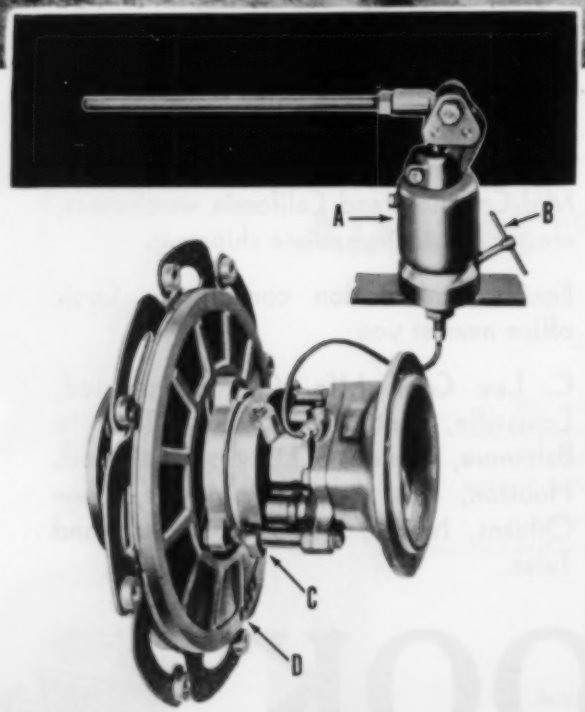
For full information contact the Cook office nearest you.

C. Lee Cook Mfg. Co., Incorporated, Louisville, Kentucky. Branch offices in Baltimore, Boston, Chicago, Cleveland, Houston, Los Angeles, Mobile, New Orleans, New York, San Francisco and Tulsa.

COOK

ROD PACKINGS

. . . SEALING PRESSURES SINCE 1888 . . .



Building Haul Roads Takes Tough Equipment

To supply the demands of a lively construction market, the lumbermen are going after the timber in the less accessible locations.

This K-500 *Mobil-Air* Compressor is helping to build a truck haul road for getting timber out of Potlatch Forest near Boville, Idaho. Its *Flex-Disc* Clutch with *Hydro-Shifter* enables it to operate freely in heat or cold at any altitude.

The *Flex-Disc* Clutch (D at left) meets the exacting requirements of portable compressor duty. Finger-tip hydraulic control is provided by the pump reservoir and handle (A) for disengaging, and the release valve (B) for engaging the clutch through the hydraulic jack unit (C). All parts are built for low maintenance and long service. The seldom needed replacements are readily made without disturbing the rest of the compressor.

INDUSTRIAL CLUTCH CORPORATION

Waukesha Wisconsin

MODERATELY PRICED SMALL STEEL VALVES FROM THE COMPLETE CRANE LINE

UNION BONNET GATES . . . MORE COMPACT, MORE RUGGED

Here's a valve value made possible by Crane Co.'s finer facilities for *quality* mass production. These low-cost, small steel gates are specially designed for a wide range of tough services. They readily withstand rough usage, piping and pressure strains, and extreme variations in temperature. The features below show how and why they do it.

COMPACT OVERALL DESIGN—size for size, these valves are more compact than the usual high-pressure design—at no sacrifice of strength.

TIGHT UNION BONNET JOINT—heavy steel union ring with long, precision-cut threads pulls up easily, stays tight, protects against distortion when joint is opened. Male and female bonnet joint with soft iron gasket eliminates possibility of gasket blowout.

LEAKPROOF BODY SEAT RINGS—are securely rolled into the body. No danger of leakage around ring. Cannot loosen in service.

FULLY GUIDED SOLID WEDGE DISC—cannot get out of line or jam in body. Disc drag and wear on seating surfaces are minimized.

GET DESCRIPTIVE FOLDER AD-1741 for more data on these valves. Gives sizes, dimensions, and service recommendations. Ask your Crane Representative for a copy or write direct. These valves also listed in your Crane No. 49 Catalog, P. 223.

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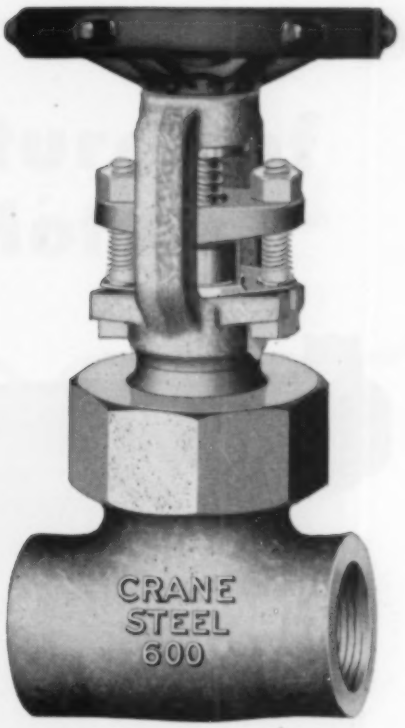
EVERYTHING FOR EVERY PIPING SYSTEM

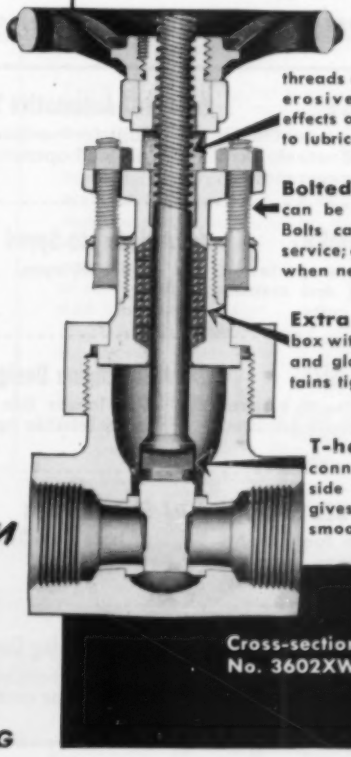
CRANE

VALVES • FITTINGS • PIPE • PLUMBING AND HEATING



No. 3602XW, 600-Pound Small Steel Gate for steam up to 850° F; for water, gas, air up to 500° F. Hardened stainless to Exelloy Seating. Sizes: ¼ to 2-inch. Screwed or welding ends.

Easy to operate . . . Easy to service



Outside screw and yoke. Stem threads are not exposed to erosive and corrosive effects of line fluids. Easy to lubricate.

Bolted packing gland can be pulled up easily. Bolts cannot come off in service; are easy to remove when necessary.

Extra deep stuffing box with one-piece gland and gland flange maintains tight stem seal.

T-head disc-stem connection prevents side strain on stem; gives flexibility for smooth operation.

Cross-section
No. 3602XW

Only Ingersoll-Rand's

NEW DIESEL

gives you BIG-ENGINE PERFORMANCE in a small package . . . 195 to 375 hp

NEVER BEFORE *have these Contradictory Characteristics been combined in one diesel engine*

	but	
MOVABLE Can be mounted on welded steel skid base for easy moving.	*but*	**NOT Automotive Type** Built for continuous, full-load operation.
LOW WEIGHT Low transportation, rigging and maintenance costs.	*but*	**Moderate Speed** 900-1000 rpm.
SMALL SIZE Minimum-engine room space required.	*but*	**Big-Engine Design** For longer life and more reliable operation.
HIGH FUEL ECONOMY 0.40 lb fuel per hp-hr means sustained low operating costs.	*but*	**Small Pistons** 7" bore x 8¼" stroke.
PERFECT BALANCE Minimum concrete foundation required.	*but*	**No Balancing Devices** 6 or 8 cylinder engine with in-line construction.

Until now the only Diesel Engines in the 195 to 375 hp range were either automotive-type units at top limits of speed and rating, or heavy, slow-speed and oversize derated engines. But now with the new Ingersoll-Rand TS Diesel you can get the small size and light weight of an automotive unit—plus the operating economy, stability, and long life of the big engine.

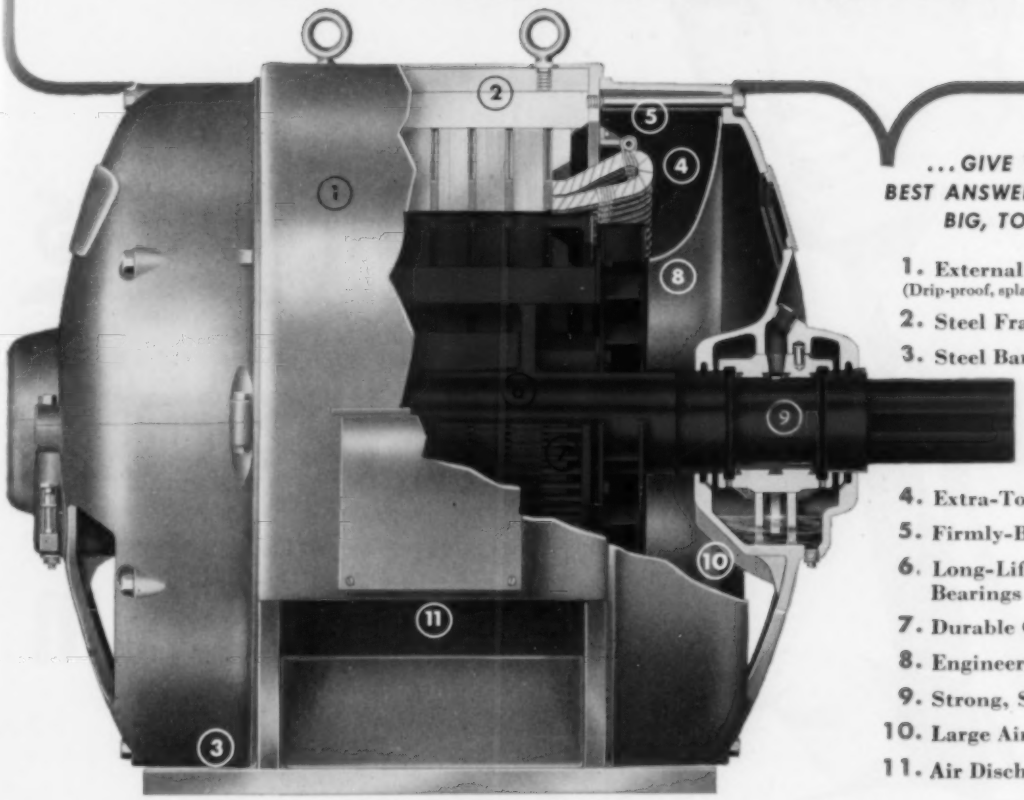
In the TS Diesel you'll find big-engine features like these: Big 5¼" crankshaft . . . full-floating, interchangeable aluminum-alloy shells for both main and crankpin bearings . . . full pressure lubrication . . . individual cylinder heads . . . replaceable cylinder liners . . . removable valve seat inserts . . . single-hole injection nozzles . . . gear-driven supercharger . . . and many others.

Call any Ingersoll-Rand branch office for complete facts on the new TS Diesel, and you'll see why it has been called the outstanding advance in engine design in the past decade. It is an ideal engine for every type of heavy-duty service.

Ingersoll-Rand

11 BROADWAY, NEW YORK 4, N. Y. 530-7

Eleven BIG features of E-M Induction Motors



...GIVE YOU THE ONE BEST ANSWER FOR HANDLING BIG, TOUGH DRIVES

1. External Protection
(Drip-proof, splash-proof or fully enclosed)
2. Steel Frame
3. Steel Bar Feet
4. Extra-Tough Coils
5. Firmly-Braced Coil Ends
6. Long-Life, Cool-Running Bearings
7. Durable Cage Windings
8. Engineered Ventilation
9. Strong, Stiff Rotor
10. Large Air Intake
11. Air Discharge at Feet

● Ever lock fenders with a commercial taxicab? Chances are your passenger car came off second best, because taxicabs are specially built to take that kind of punishment.

Big motors have to take punishment, too. They must have greater ruggedness and stamina than small motors. That's why it's significant that E-M Heavy-Duty Induction Motors are built by big-motor specialists—the same people who have made E-M Synchronous Motors a byword for toughness and reliability.

Just look at the design and construction features shown above. Each is a factor in the dependable performance of E-M Heavy-Duty Induction Motors, year in and year out. They explain why maintenance is held at a minimum when an E-M Heavy-Duty Induction Motor is on the job.

ELECTRIC MACHINERY MFG. COMPANY
MINNEAPOLIS 13, MINNESOTA

1300-TPA-2084

You'll enjoy reading our special issue of THE SYNCHRONIZER, "The ABC of Large Induction Motors." This 32-page booklet is written by G. L. Oscarson, our Chief Application Engineer, and presents a comprehensive, practical, fact-filled treatment of Induction Motor fundamentals. It is lavishly illustrated with installations, photographs, cutaway views of squirrel-cage motors, and has nearly fifty graphs with explanatory figures accompanying the text. Get a copy from your E-M man, or write us direct.

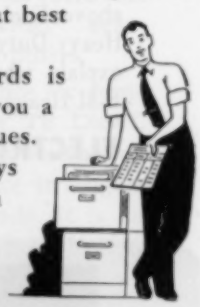
E-M

SPECIALISTS IN BIG MOTOR ENGINEERING

This man knows what his wire rope costs him

He's quit guessing. Now he knows what his wire rope *actually* costs. He learned long ago that purchase price alone doesn't tell him a thing. So he devised a simple system of records—records that show the amount of work his ropes do, and their cost per unit of work.

This is something that Bethlehem has always recommended. To get a true picture of rope costs—an accurate picture—you should have figures showing the cost per ton-mile, yard of rock moved, or other unit that best applies to your business.



The keeping of such records is good, sound practice. Gives you a chance to compare rope values. That we like—for we're always ready to stack the Bethlehem product against all comers. You'll be, too—when you use this rope consistently.

LET YOUR RECORDS TELL YOU!

BETHLEHEM STEEL COMPANY, BETHLEHEM, PA.

On the Pacific Coast Bethlehem products are sold by Bethlehem Pacific Coast Steel Corporation

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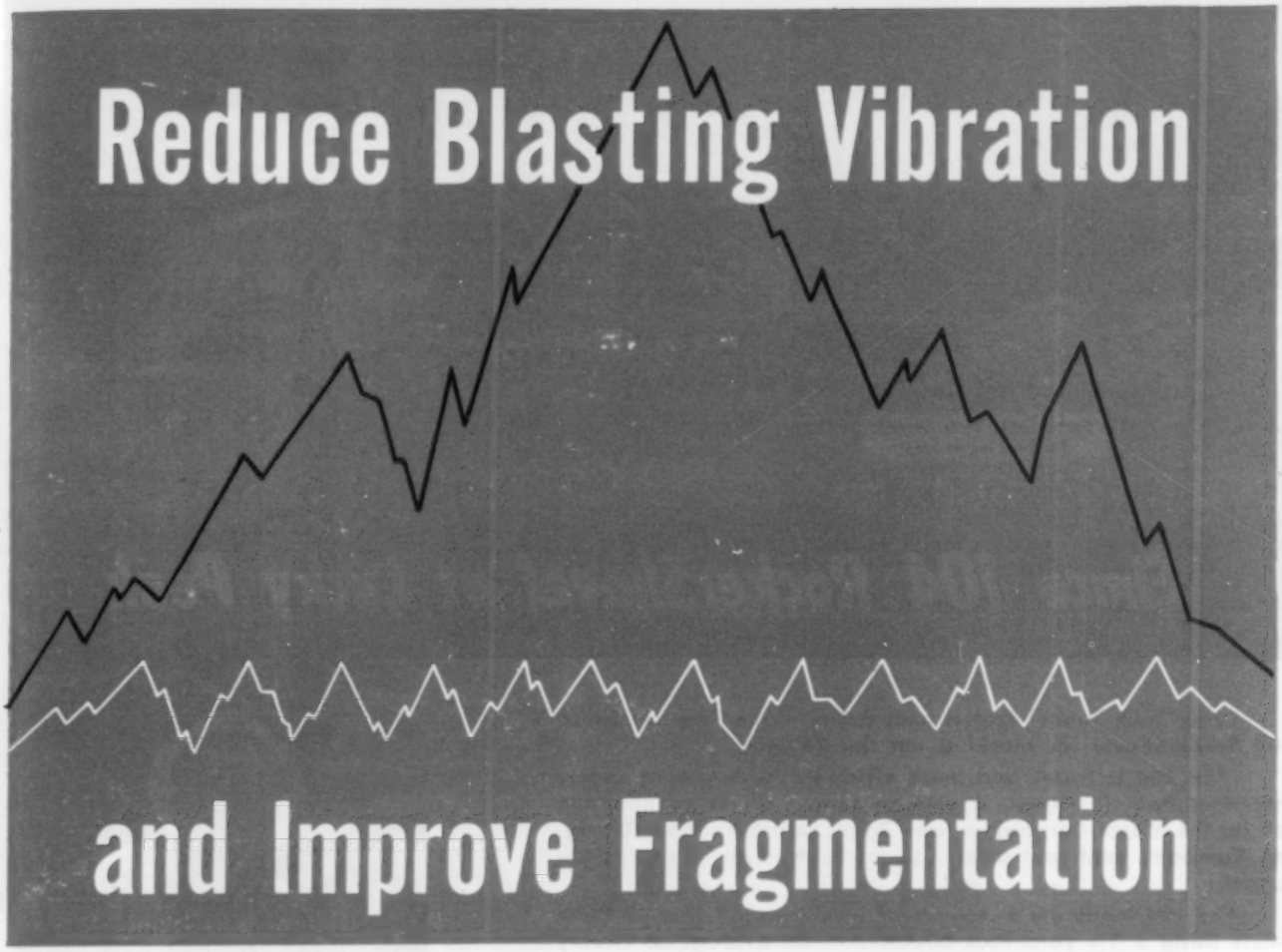
Reduce Blasting Vibration

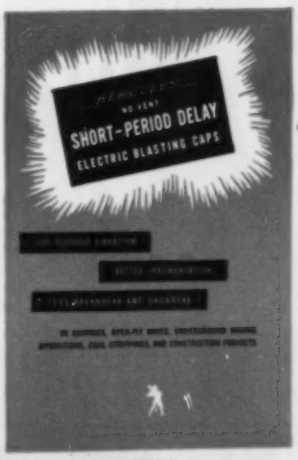


and Improve Fragmentation

In many blasting operations you get more work out of your explosives when you use Hercules "No-Vent" Short-Period Delay Electric Blasting Caps. You reduce earth vibrations, noise, backbreak, and endbreak; and at the same time get better fragmentation. You break more material, and break it in better shape for digging, hauling, and crushing. This saves you money at every step in your operation.

A complete series of Short-Period Delays gives twelve closely-timed delay intervals in approximately 400 milliseconds. By various arrangements of these delays, the delay effect is secured in blasts of practically any number of holes.

For details and guidance in using "No-Vent" Short-Period Delays in quarries, open-pit mines, underground mines, coal stripping, and construction, return coupon.



Return Coupon for 12-Page Descriptive Booklet

HERCULES POWDER COMPANY
INCORPORATED
932 King Street, Wilmington 99, Delaware

Send 12-page booklet, "Hercules No-Vent Short-Period Delay Electric Blasting Caps."

Name_____ Title_____

Company_____

Street_____

City_____ State_____

"NO-VENT" IS A TRADE-MARK

XR50-7

Portal Lucky Peak Tunnel
26' Bore inside steel

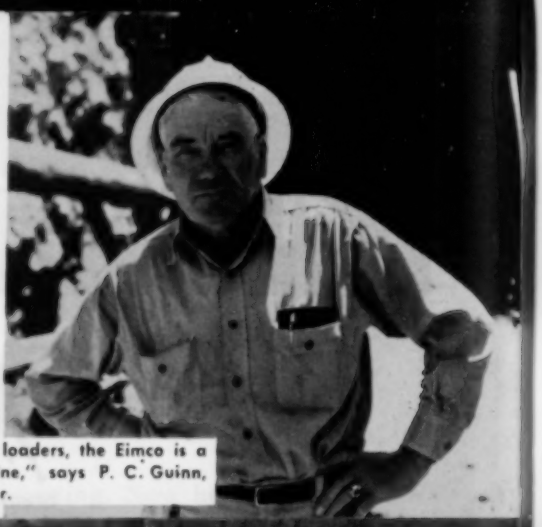
Eimco 104 RockerShovel at Lucky Peak

Lucky Peak Tunnel Project near Boise, Idaho, uses an Eimco 104 RockerShovel for mucking out the 26' bore.

"The 104 is faster and more efficient," says project superintendent Paul C. Guinn, a veteran tunnel driver running the job for the Macco Corporation and Puget Sound Bridge & Dredging Company joint contractors. Lucky Peak is Mr. Guinn's 59th tunnel.

The 104 loads the 8' rounds of blocky basalt rock in three hours using a 1¼ yard rock bucket . . . an average of twenty WD-60 Dumptor loads per hour.

Eimco 104 RockerShovels will cut the cost of loading on your job, too. Write for more information.



"In comparing loaders, the Eimco is a mucking machine," says P. C. Guinn, project manager.

EIMCO

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The World's Largest Manufacturers of Underground Rock Loading Machines

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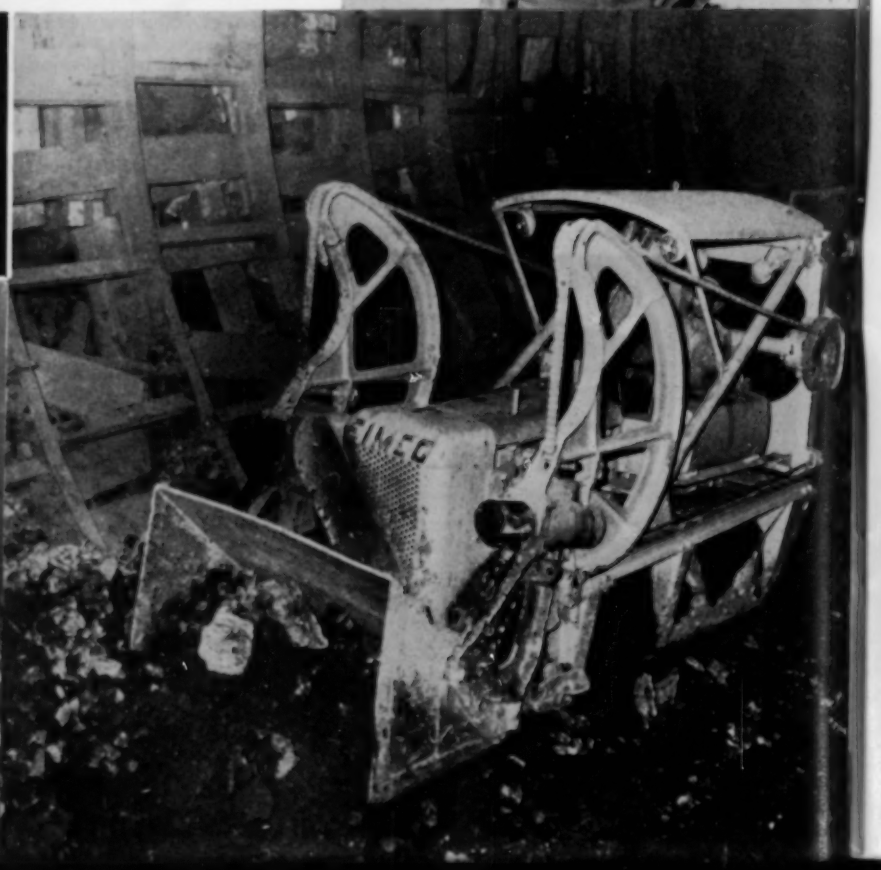

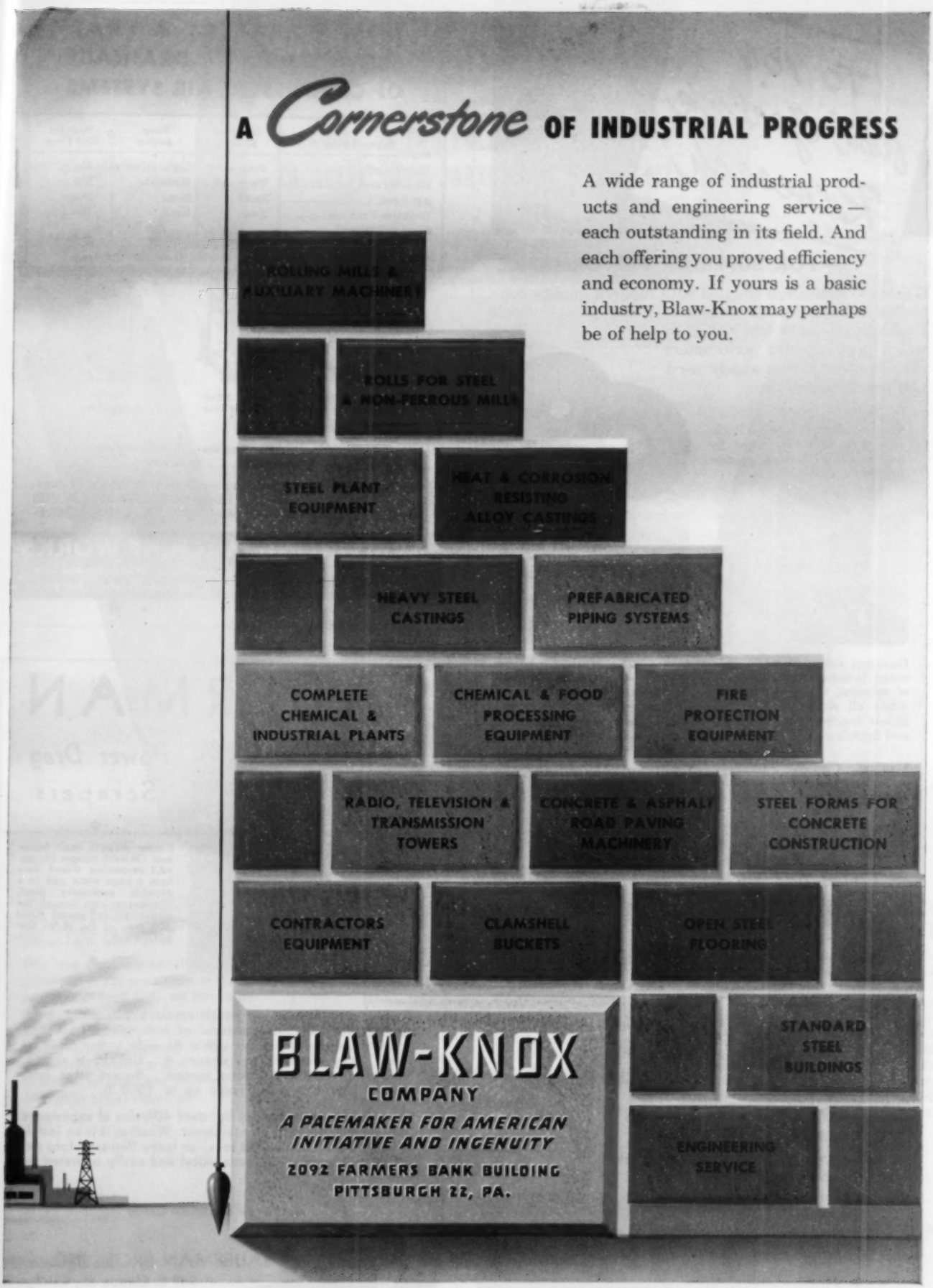
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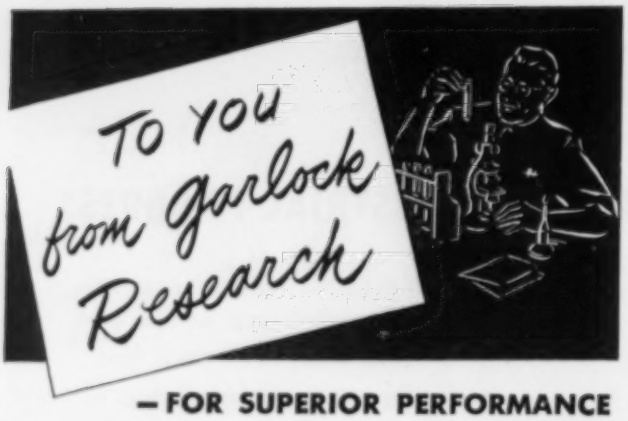
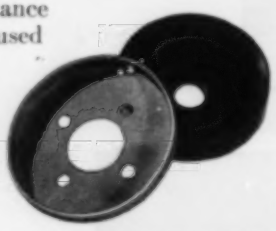
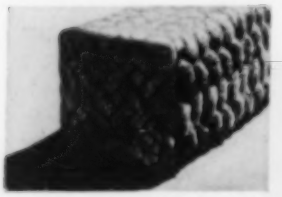


—FOR SUPERIOR PERFORMANCE

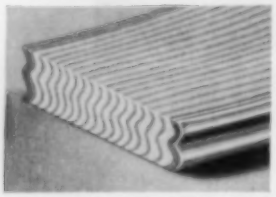
GARLOCK RESEARCH coupled with modern quality controlled manufacturing processes bring you Garlock Packings, Gaskets and Oil Seals which give superior performance consistently. A few widely used Garlock products are:



GARLOCK *Bitan** Leather Packings—tanned and treated by an exclusive Garlock process for severe service.



GARLOCK *Lattice-Braid*—a patented braided packing, made of asbestos, flax or cotton—in which all strands are lattice-linked together into a sturdy and flexible unified structure.



GARLOCK *Guardian** Gaskets—spirally wound metal and asbestos—are extremely resilient. Recommended for use against the highest temperatures and pressures.

GARLOCK *Chevron** Packing—an automatic packing made of asbestos or cotton base materials—accurately molded into rings of any size. Chevron packs high pressure jobs or low pressure jobs with minimum friction and wear.

GARLOCK *KLOZURE** Oil Seal Models 53 and 63—tough, durable, resilient. Complete range of sizes, including Metric O.D.

*Reg. U.S. Pat. Off.

Write for folders

THE GARLOCK PACKING COMPANY
PALMYRA, NEW YORK

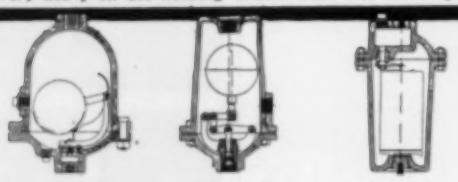
In Canada: The Garlock Packing Company of Canada Ltd., Montreal, Que.

GARLOCK

HOW TO SELECT A TRAP FOR AUTOMATIC DRAINAGE OF COMPRESSED AIR SYSTEMS

Type of Trap	Inverted Bucket	Snap Action	Regular Ball Float
Handles oil	Very well*	Light oil only	No
Handles dirt	Very well	Moderate	No
Air Loss	Small	None	None
Requires Priming	Yes	No	No
Float collapse or leakage	Impossible	Remote	Remote

*For very heavy oil use nothing smaller than No. 213 trap.



No. 71 Snap Action Air Trap | No. 2 Ball Float Trap | Inverted Bucket Trap

WHERE TO USE THEM

Drip Points . . . After Coolers . . . Intercoolers . . . Separators . . . Receivers

Get full details on Armstrong automat c drainage of compressed air lines. Ask for Bulletin 202 ARMSTRONG MACHINE WORKS, 885 Maple St., Three River, Mich.

ARMSTRONG MACHINE WORKS

Manufacturers of Air Traps, Steam Traps, Steam Humidifiers and High Side Floats and Purgers for Refrigeration Systems.

SAUERMAN

Power Drag Scrapers

Picture shows a small Sauerman Crescent Scraper (⅓ cu. yd.) reclaiming slaked lime from a huge waste pile to a portable processing plant. The scraper cuts through the outer crust and moves about 300 tons of the sticky material a day.

A Sauerman Scraper can reach across a pit, pond, bank or stockpile and move material at high speed from one point to another anywhere within its wide radius of operation. Any mechanic can operate it. Upkeep is simple. Sturdy construction for long service. Bucket sizes from ⅓ to 15 cu. yd.; spans range up to 1000 ft.

These machines are backed by over 40 years of experience in designing this type of equipment. Whether it is an installation to handle a hundred tons, or many thousand tons per day, it will be efficient, economical and easily operated by one man.

Write for our new Scraper Catalog

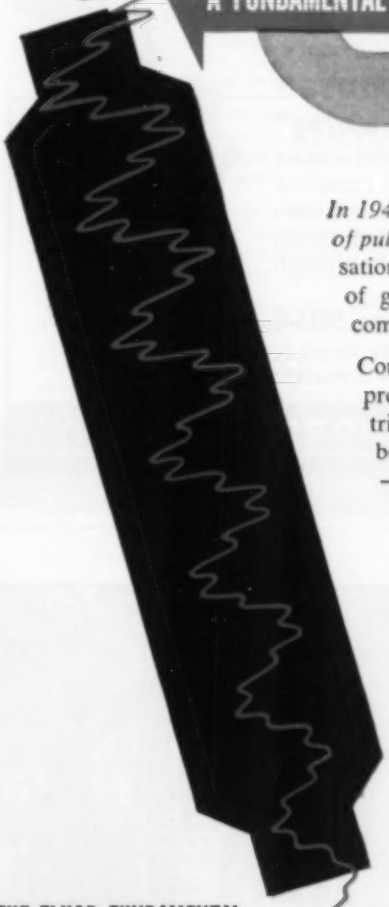
SAUERMAN BROS., INC.
548 S. Clinton St., Chicago 7

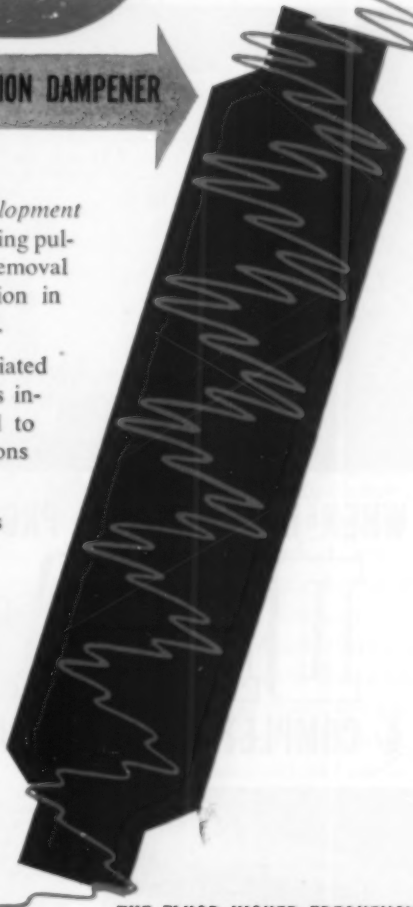
only FLUOR offers this selection

A CHOICE OF TWO PULSATION DAMPENERS TO SOLVE YOUR PARTICULAR PROBLEM!

A FUNDAMENTAL PULSATION DAMPENER

A HIGHER FREQUENCY PULSATION DAMPENER





In 1943, The Fluor Corporation pioneered the development of pulsation dampeners. The first U. S. Patent covering pulsation dampeners designed specifically for the removal of gas stream pulsation and subsequent vibration in compressor piping was issued to Fluor in 1946.

Continued research in gas pulsation and its associated problems has established that pulsation, and its intricate secondary vibration, can be attributed to both fundamental and high frequency pulsations *—or to high frequency components alone.*

Whichever of these destructive conditions exists in your plant, Fluor offers a dampener engineered to fit the requirements of the specific problem. Fluor—and only Fluor—offers such a complete range of pulsation dampeners. For this reason you can be assured of an unbiased recommendation on the best type dampener for your *particular* requirements.

THE FLUOR FUNDAMENTAL PULSATION DAMPENER

This type dampener smooths out all pulsations in the gas stream to the extent of at least 85%. All harmonics originally set up in each pulse cycle are automatically reduced or eliminated. This dampener is the guaranteed answer in plants where structural vibration and metering difficulties are encountered—irrespective of pulsation frequency.

MAKE YOUR OWN PRELIMINARY SURVEY

In many cases you can make your own preliminary survey to determine roughly if your pipe vibration is caused by pulsations. Write The Fluor Corporation, Ltd., Los Angeles 22, California, indicating layout of compressor house piping and operating pressures. A procedure will be mailed to you promptly. No obligation.

THE FLUOR HIGHER FREQUENCY PULSATION DAMPENER

This dampener removes objectionable pulsation frequencies encountered above the fundamental. In many instances, it has been found that metering difficulties and vibration of compressor piping and nearby vessels have been caused by the higher frequency components alone. Available in both manifold and in-line types, this dampener is competitive in cost with muffler or snubber type devices.

FLUOR

BE SURE WITH FLUOR — ENGINEERS • CONSTRUCTORS • MANUFACTURERS

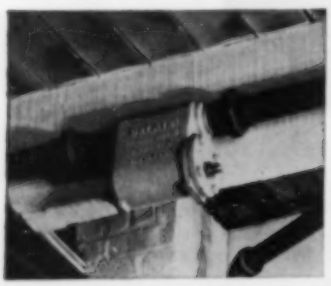
THE FLUOR CORPORATION, LTD., 2500 S. Atlantic Blvd., Los Angeles 22, Calif. Offices in principal cities in the United States
REPRESENTED IN THE STERLING AREAS BY: Head Wrightson Processes Ltd., Teesdale House, Baltic Street, London, E.C.I., England

DEPENDABLE PNEUMATIC SERVICE

WHEN EQUIPMENT IS PROTECTED BY

DRIAIR

A COMPLETE SELF-CONTAINED UNIT



DriAir may be installed by suspending it from the piping, without any other support, or may stand on the floor near equipment being protected.

DRIAIR speeds production by separating and automatically ejecting the condensed water and oil from the air. DriAir collects dirt and rust from the air lines and delivers clean dry air to the tools, thus reducing wear and prolonging their life. All internal parts are made of bronze or copper—resistant to corrosion and practically permanent. Copy of Bulletin DA fully describing the operation of DriAir sent on request.

NEW JERSEY METER COMPANY

PLAINFIELD, NEW JERSEY

Pressure Switch

FOR AIR COMPRESSORS AND WATER PUMPS

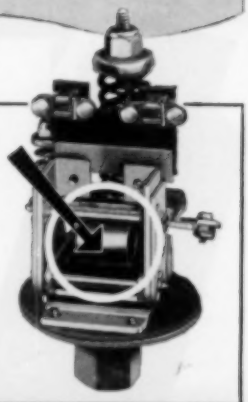
CLASS 9013 • TYPES GHG and GSG

"POWER HOUSE"
Snap-Action Spring

provides powerful contact snap action and complete valve opening with air compressor switches at all ranges of operation—40 lbs. through 200 lbs. P.S.I.

Write for Bulletin **9013-G**

Square D Company, 4041 N. Richards St.
Milwaukee 12, Wisconsin



SQUARE D COMPANY

DETROIT • MILWAUKEE • LOS ANGELES

A *Tough* HOSE FOR *Rough* SERVICE!

The Goodall "Standard of Quality" hose you can rely on for safe, low-cost service in all heavy-duty air tool applications. Extra strong wrapped duck construction. Wear-resistant *red* cover. Sizes ½" to 1¼", in lengths up to 50 feet.

"SUBWAY" *Heavy Duty* AIR HOSE

Contact Our Nearest Branch for Complete Information.

GOODALL RUBBER COMPANY

GENERAL OFFICES, MILLS and EXPORT DIVISION, TRENTON, N. J.

Branches: Philadelphia · New York · Boston · Pittsburgh · Chicago · Detroit · St. Paul · Los Angeles
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Est. 1870

Why WISCONSIN ENGINES are Air-Cooled

Air-Cooling, as developed and perfected by Wisconsin Motor Corporation engineers, has these important advantages for the power user:

1. Greatest freedom from cooling chores and troubles. More Service FROM the engine, less service TO the engine; fewer Man-Hours lost; more H. P. Hours on the job.

2. Most efficient cooling at all engine speeds and all temperatures, from sub-zero to tropical highs. The engine never runs out of AIR!

3. Lowest maintenance cost. Integrally cast flywheel fan eliminates all cooling "accessories" . . . nothing to get out of order, wear out, or require replacement.

4. Lighter engine weight and greater compactness . . . for most convenient portability and greatest installation adaptability as power components on original equipment.

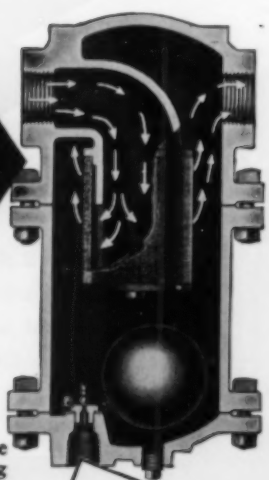
Every Wisconsin Engine from the smallest to the largest (3 to 30 hp., single cylinder, 2-cylinder and 4-cylinder) has all the advantages of dependable AIR-COOLING, plus heavy-duty design and construction throughout.

WISCONSIN MOTOR CORPORATION

World's Largest Builders of Heavy-Duty Air-Cooled Engines

MILWAUKEE 46, WISCONSIN

NO MOISTURE OR DIRT GETS BY HERE



Johnson Self-Draining Compressed Air Separator.....

Like all Johnson Separators the new Type "SA" Self-Draining Separator combines the two most effective principles of removing moisture and dirt from compressed air:

1. Controlled expansion of air in separator precipitates most of the moisture.
2. A "thousand baffles" of coarse mesh repeatedly changes flow of direction to capture remaining foreign matter.

Self-Draining—a simple but complete trap mechanism built right in, automatically drains separator whenever necessary.

Johnson Separation Devices include Separators for Compressed Air or Steam. After coolers, oil absorbers.

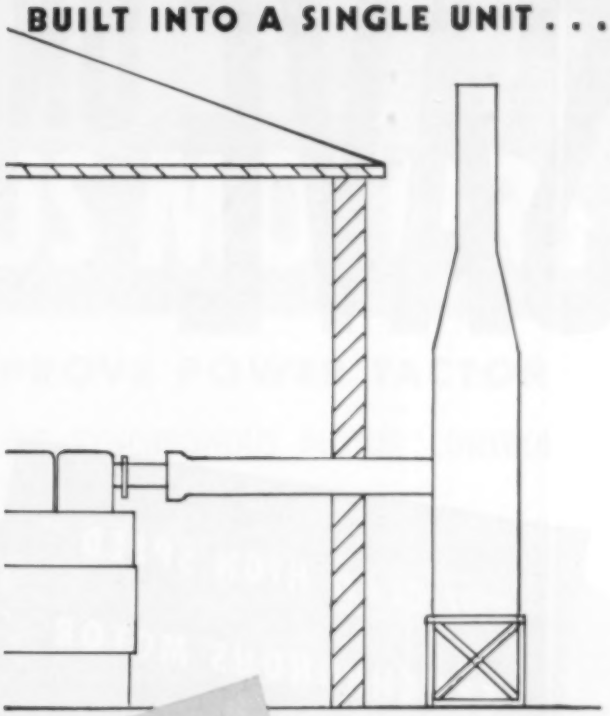
WRITE FOR CATALOG

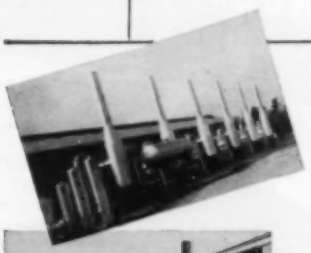
The Johnson Corporation

830 WOOD STREET — THREE RIVERS, MICH.

ADEQUATE SILENCING

BUILT INTO A SINGLE UNIT . . .

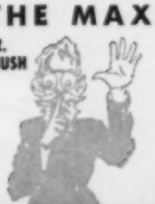




A single silencer outside and only the exhaust piping inside — a space saving installation — and a flexible one because exhaust can be run high, low, or underground with the Maxim Air Induction Silencer. The inlet can be placed where you want it. Hot air is drawn out of the engine room, and piping and silencer are both cool so that paint will stay on. Investigate this *most practical* way to get adequate silencing and engine room ventilation.

SEND FOR BULLETIN

THE MAXIM SILENCER COMPANY



61 HOMESTEAD AVE. HARTFORD 1, CONNECTICUT

Please send AIR INDUCTION SILENCER bulletin.

NAME _____

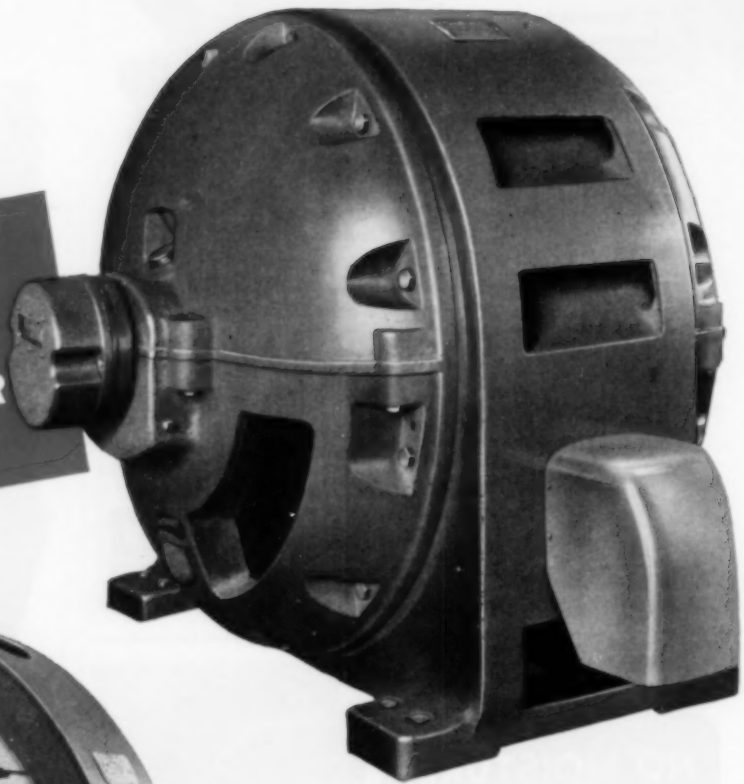
COMPANY _____

ADDRESS _____

BE SURE IT'S A

MAXIM

SAVE ON POWER BILLS



TRI-CLAD HIGH SPEED
SYNCHRONOUS MOTOR

LOW SPEED
SYNCHRONOUS MOTOR

WITH GENERAL ELECTRIC SYNCHRONOUS MOTORS

SYNCHRONOUS MOTORS IMPROVE POWER FACTOR

1. Save you penalty charges for poor power factor

2. Save money by reducing demand and releasing needed generating capacity

Here's an example:

One company improved power factor from 72 to 84 per cent by installing a 300 hp .8 leading power factor G-E synchronous motor in place of another motor. This corrected power factor released 260 kva capacity in their generating equipment and allowed installation of additional motors.

These savings in cost of operation are available to you.

Savings in the initial cost of equipment are also available—when synchronous motors are used in their natural fields of application. To find out about these natural fields of application, get in touch with our nearest office.

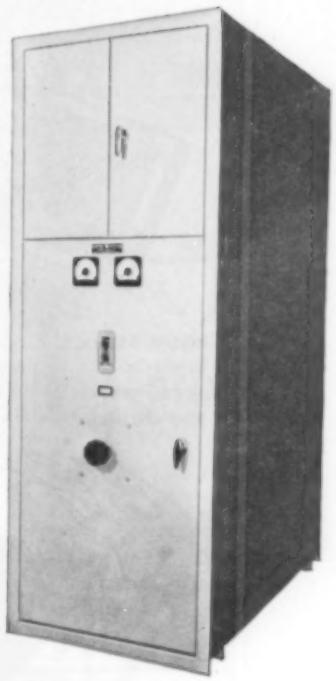
REMEMBER—General Electric Synchronous motors—whenever you need constant speed. They can give you lower initial cost, lower operating cost. For bulletin information, fill in the coupon:

G-E SYNCHRONOUS MOTOR CONTROL INCREASES YOUR SAVINGS

G-E synchronous control provides the accurate adjustments that enable you to improve power factor. Here's where details count—where the slightest variation of a pointer on a meter means money saved—or lost. And General Electric has not overlooked these elements. Consider the meters for a moment. Here, G-E has devised a long scale with the pointer in the same plane as the figures so there can be no possibility of misreading the instrument. Anti-glare glass is used so no distortion is possible.

The new smaller rheostat, too, has design features that not only result in longer life but in greater operating convenience and accuracy. The handle has been molded to fit the fingers of the operator—to prevent slippage and over correction. You can be sure, too, that the new field circuit will respond instantly to rheostat adjustment.

Protection is assured the operator through the attractive steel enclosure. The cabinet resists blows, keeps out dirt and other operating hazards. All live parts are strongly guarded. Plant appearance is improved with this control designed to line up with other G-E power units such as switchgear. Ask your nearest G-E office for more information about this equipment that safeguards your investment . . . helps save operating expenses.



GENERAL ELECTRIC

Apparatus Dept., Sec. N770-6
General Electric Co., Schenectady, N. Y.

Gentlemen:

Please send me: ☐ GEA-5332, Low-speed Synchronous Motors; ☐ GEA-5426, High-speed Synchronous Motors; ☐ GEC-505, Synchronous Motor Control.

Bulletins needed for:

☐ Reference purposes ☐ Planning immediate project

Name.....

Position.....

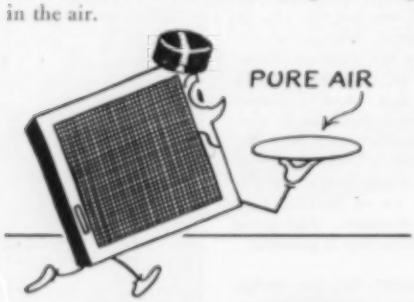
Address.....

City..... Zone..... State.....

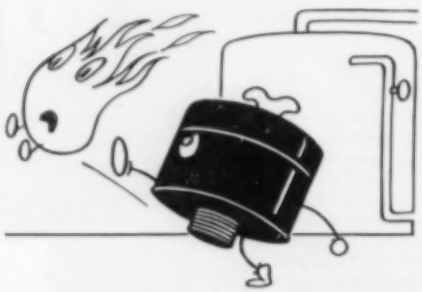
AIR-MAZING FACTS

BY O. SOGLOW

DUST GOES SKY-HIGH. The hustle and bustle of modern living really makes the dust fly. You can go as high as 15,000 feet above sea level and still find dust and grit floating in the air.



ROOM SERVICE. Air-Maze panel filters keep hotels cleaner and guests happier with plenty of clean, fresh air. All-metal cells are easy to clean, provide high efficiency, low pressure drop.



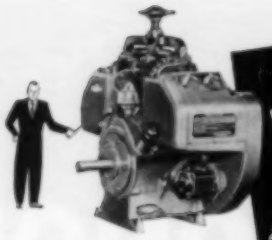
NO ADMITTANCE! Flame, sparks and dirt can't get past a tank vent that has an Air-Maze flame arrester. For use on tanks where inflammable liquids are stored, Air-Maze approved flame arresters give dependable protection. Just one more of the hundreds of Air-Maze filter types and sizes.

WHETHER YOU build or use engines, compressors, air conditioning and ventilating equipment, *or any device using air or liquids*—chances are there is an Air-Maze filter *engineered* to serve you better. Representatives in all principal cities, or write Air-Maze Corporation, Cleveland 5, Ohio.

AIR-MAZE

The Filter Engineers

AIR FILTERS
SILENCERS
SPARK ARRESTERS
LIQUID FILTERS
OIL SEPARATORS
GREASE FILTERS

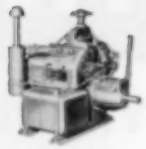


Why **WISCONSIN FOUR-CYLINDER** *Air-Cooled* **ENGINES ARE ALL V-TYPE**

1. V-type design provides a more compact power package for easier, more adaptable installation on original equipment.
2. V-type design means lighter weight, adding to ease of handling and mobility.
3. V-type design provides most efficient air cooling — the air blast travels only half as far as required for a 4-cylinder "straight-in-line" engine.
4. More uniform cooling of V-type engines assures more economical and smoother engine performance; lower maintenance cost; longer engine life.
5. V-type cylinders are cast in pairs, 2 cylinders to a block, thus greatly reducing replacement cost if and when that should be necessary and simplifying servicing.

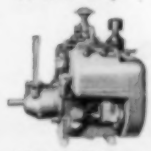
Wisconsin V-type 4-cylinder design is typical of the advanced engineering know-how that goes into all Wisconsin Engines . . . 4-cycle single cylinder, 2-cylinder and 4-cylinder models, in a complete power range from 3 to 30 hp. Write for detailed data.

V VE-4



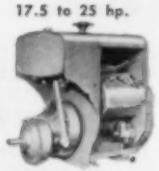
15 to 21.5 hp.

V VF-4

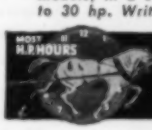


17.5 to 25 hp.

V VP-4



26.8 to 31 hp.



WISCONSIN MOTOR CORPORATION

World's Largest Builders of Heavy-Duty Air-Cooled Engines

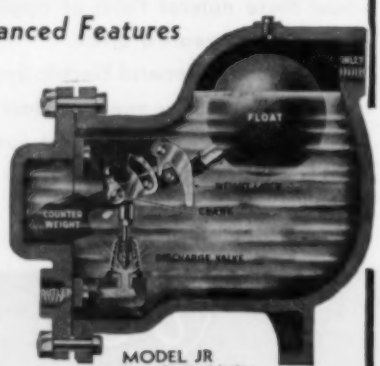
MILWAUKEE 46, WISCONSIN

Nicholson Air Traps Assure

POSITIVE DRAINAGE OF AFTERCOOLERS

by 2 Advanced Features

1) Positive Fluid Seal Over Discharge Valve—As a result of this feature Nicholson traps are increasingly specified wherever loss of air is a problem in drainage of aftercoolers, intercoolers, separators, receivers, etc.



MODEL JR

2) Extra Large Discharge Capacity—Valve opens wide instantaneously to discharge water, oil and dirt, after which it closes tight—instantaneously.

OTHER TROUBLE-PROOF FEATURES Non-wire drawing; not dependent on float to raise valve; of stainless steel where it counts, to prevent corrosion; rugged, for unavoidable abuse. 3 types for press. to 1500 lbs.

Catalog 250 or see Sweet's

W. H. NICHOLSON & CO. 180 OREGON STREET WILKES-BARRE, PA.

Valves ★ Traps ★ Steam Specialties

In strip mining, for shovel hoist and draglines, Roebling Preformed "Blue Center" Wire Rope with Independent Wire Rope Core is outstanding for small and medium size equipment . . . often preferred for 20- to 40-yard machines.

For rope research and developments that help you save...

Today it's Roebling!

YEAR BY YEAR, industry makes new and more stringent demands upon wire rope . . . and Roebling leads in developing types that meet these demands with utmost efficiency and economy.

Take Roebling Preformed "Blue Center" Wire Rope with Independent Wire Rope Core!

No finer rope has ever been made, and its basis is "Blue Center" steel—an exclusive Roebling development. Its high resistance to abrasion, shock and fatigue spells long life . . . To this, Roebling *Preforming* brings the further advantages of new handling ease and improved performance . . . And the addition of I.W.R.C. assures top resistance to operating pressures and provides increased rope strength.

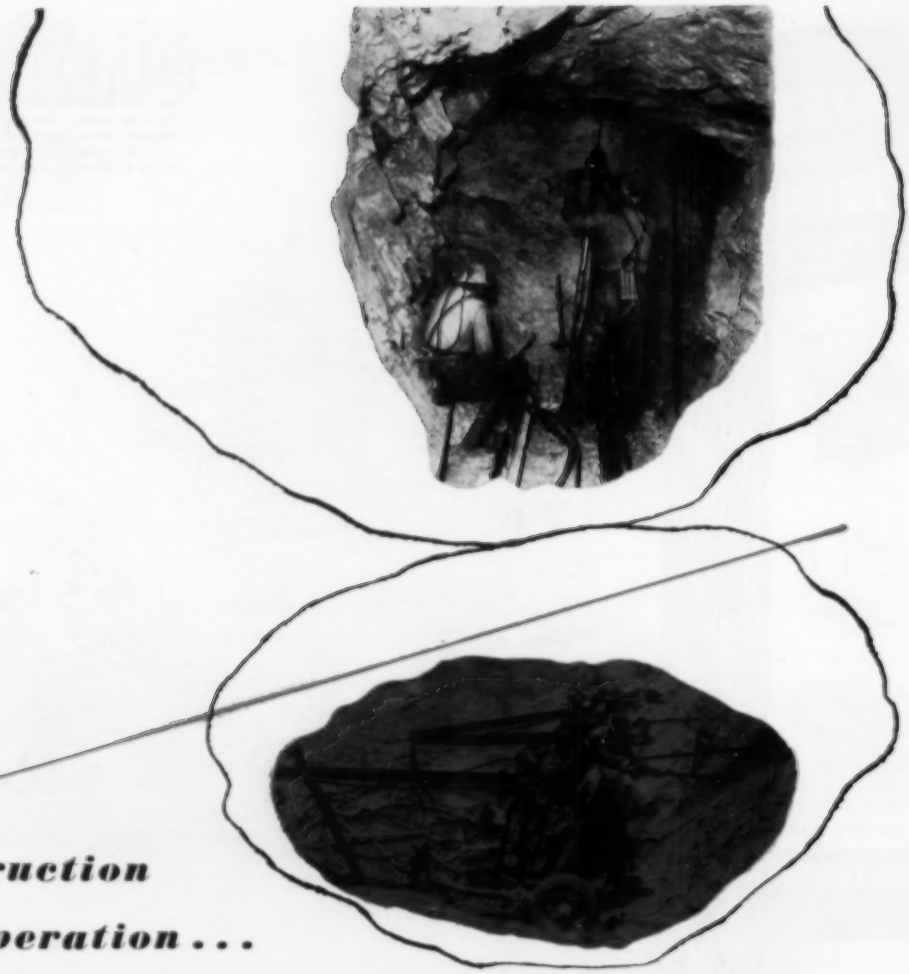
Roebling makes a wire rope of the right construction, grade and size for every type and make of rope-rigged equipment. Have your Roebling Field Man recommend the best rope for low-cost performance on each of your installations.

ROEBLING

A CENTURY OF CONFIDENCE

Atlanta, 934 Avon Ave. ★ *Boston*, 51 Sleeper St. ★ *Chicago*, 5525 W. Roosevelt Road ★ *Cincinnati*, 3253 Fredonia Ave. ★ *Cleveland*, 701 St. Clair Ave., N. E. ★ *Denver*, 4801 Jackson St. ★ *Houston*, 6216 Navigation Blvd. ★ *Los Angeles*, 216 S. Alameda St. ★ *New York*, 19 Rector St. ★ *Philadelphia*, 12 S. Twelfth St. ★ *Portland*, 1032 N. W. 14th Ave. ★ *San Francisco*, 1740 Seventeenth St. ★ *Seattle*, 900 First Avenue S.

JOHN A. ROEBLING'S SONS COMPANY, TRENTON 2, NEW JERSEY



in every construction drilling operation . . .

CRUCIBLE HOLLOW DRILL STEEL

cuts costs

In mines and quarries, roads and tunnels Crucible Hollow Drill Steel is giving users *lower cost per foot drilled*. Controlled hardenability, excellence of stress-bearing surfaces and uniform processing all contribute to the assurance that Crucible Hollow Drill Steel will cut costs in your drilling operation.

To make these economies more than just a promise . . . *every lot* of Crucible Hollow Drill Steel is *pretested*. Crucible's drilling tests *before* the steel is shipped is another reason why you can count on Crucible to deliver the drill steel you need to keep your costs down!

So, when you ask for CRUCIBLE, you know that lot after lot is produced to chemical uniformity—proven by performance under field conditions. What's more you get fast field service, alert metallurgical advice, countrywide stocks. Check our local representative, he can help you. CRUCIBLE STEEL COMPANY OF AMERICA, Chrysler Building, New York 17, N. Y.

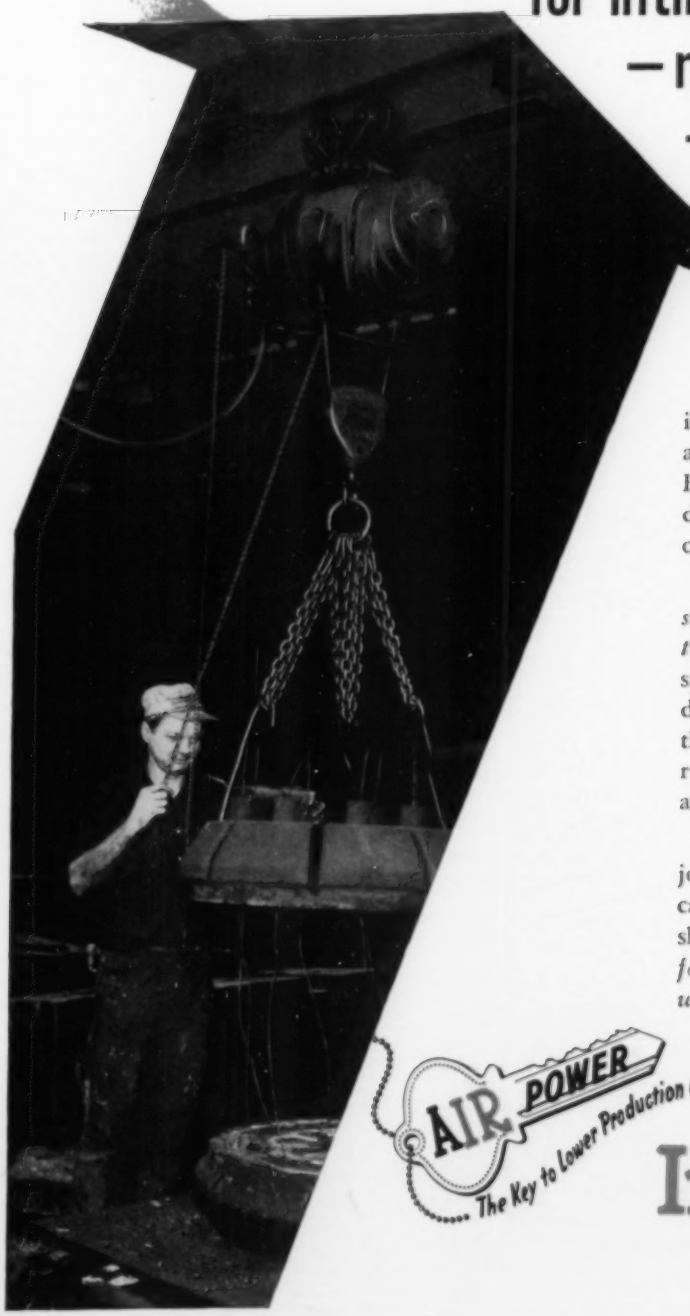
CRUCIBLE first name in special purpose steels

HOLLOW DRILL STEEL

HIGH SPEED • TOOL • STAINLESS • ALLOY • MACHINERY • SPECIAL PURPOSE • STEELS

compressed air has the *Lifting Power*

I-R Air Hoists have the *Reputation* for lifting loads and profits —raising output —lowering fatigue



Too much human energy is wasted in the nation's industries doing laborious and back-breaking lifting and moving jobs. Agreed? Then let I-R Air Motor Hoists, large and small, eliminate this costly handling! When you use them, output goes up, costs come down.

Sturdy, compact, foolproof I-R Air Hoists are *safe* hoists; because the operator has *complete control* at all times, whether the hoist is running at full speed or at the slowest crawl. Automatic up and down stops prevent damage through misuse to both the hoist and the load. I-R Air Hoists are fine for rugged service, and work just as well in hot gaseous atmospheres.

You can't go wrong when I-R Hoists are on the job. Sizes available from 200 to 20,000 pounds capacities. Ask one of our Air Tool Specialists to show you how *Air Hoists and Air Tools now pay for themselves nearly twice as fast and enable the workman to do more work with less effort.*

AIR POWER
The Key to Lower Production Costs

Ingersoll-Rand

11 Broadway, New York 4, N. Y.

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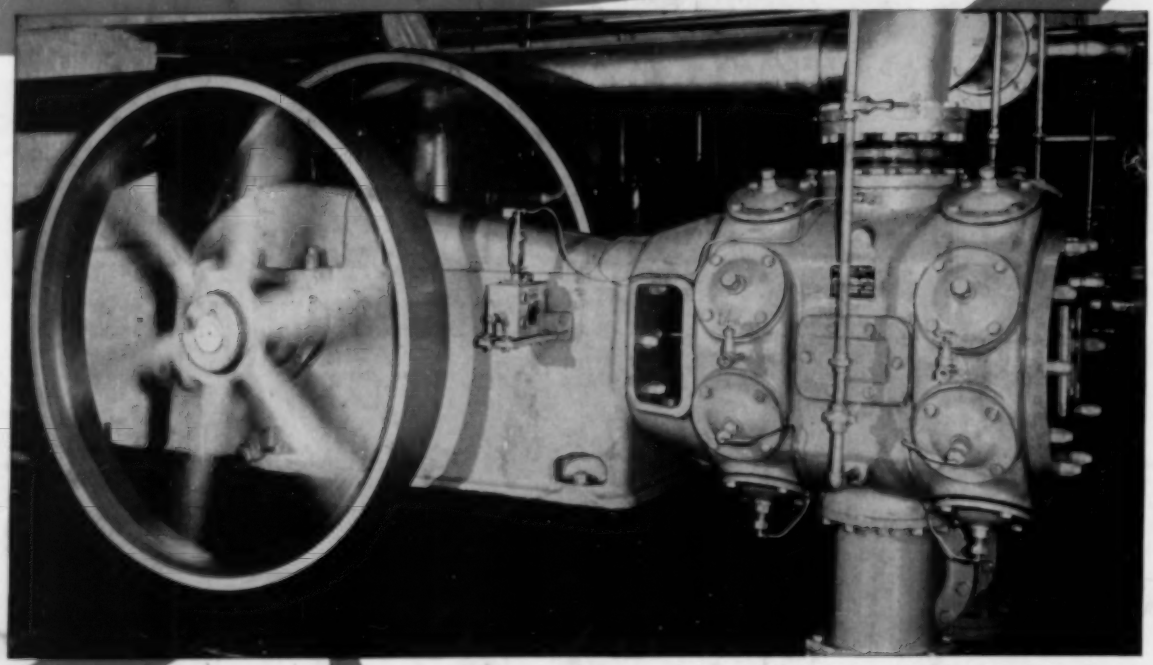
WHEN MOISTURE IS A PROBLEM



DO THIS!

Use the Texaco air compressor oil recommended for wet conditions

Water in cylinders, caused by sweating due to low jacket temperatures, is sometimes a source of trouble in air compressor operation. To overcome this condition lubricate cylinders with the Texaco compounded oil recommended by your Texaco Lubrication Engineer. It will resist the washing action of the water and assure more effective lubrication.

Whatever your operating conditions, there is a Texaco air compressor oil to assure cleaner, more efficient operation, with minimum wear and reduced maintenance costs. In addition to compounded oils for water conditions, Texaco has inhibited oils for rust prevention, heavy-duty oils to overcome carbon and gum troubles, straight mineral oils for normal service.

Let a Texaco Lubrication Engineer help you select the proper lubricants for your particular operating conditions. Just call the nearest of the more than 2,000 Texaco Wholesale Distributing Plants in the 48 States, or write:

The Texas Company, 135 East 42nd Street, New York 17, N. Y.

TEXACO

TEXACO Air Compressor Oils

FOR ALL OPERATING CONDITIONS